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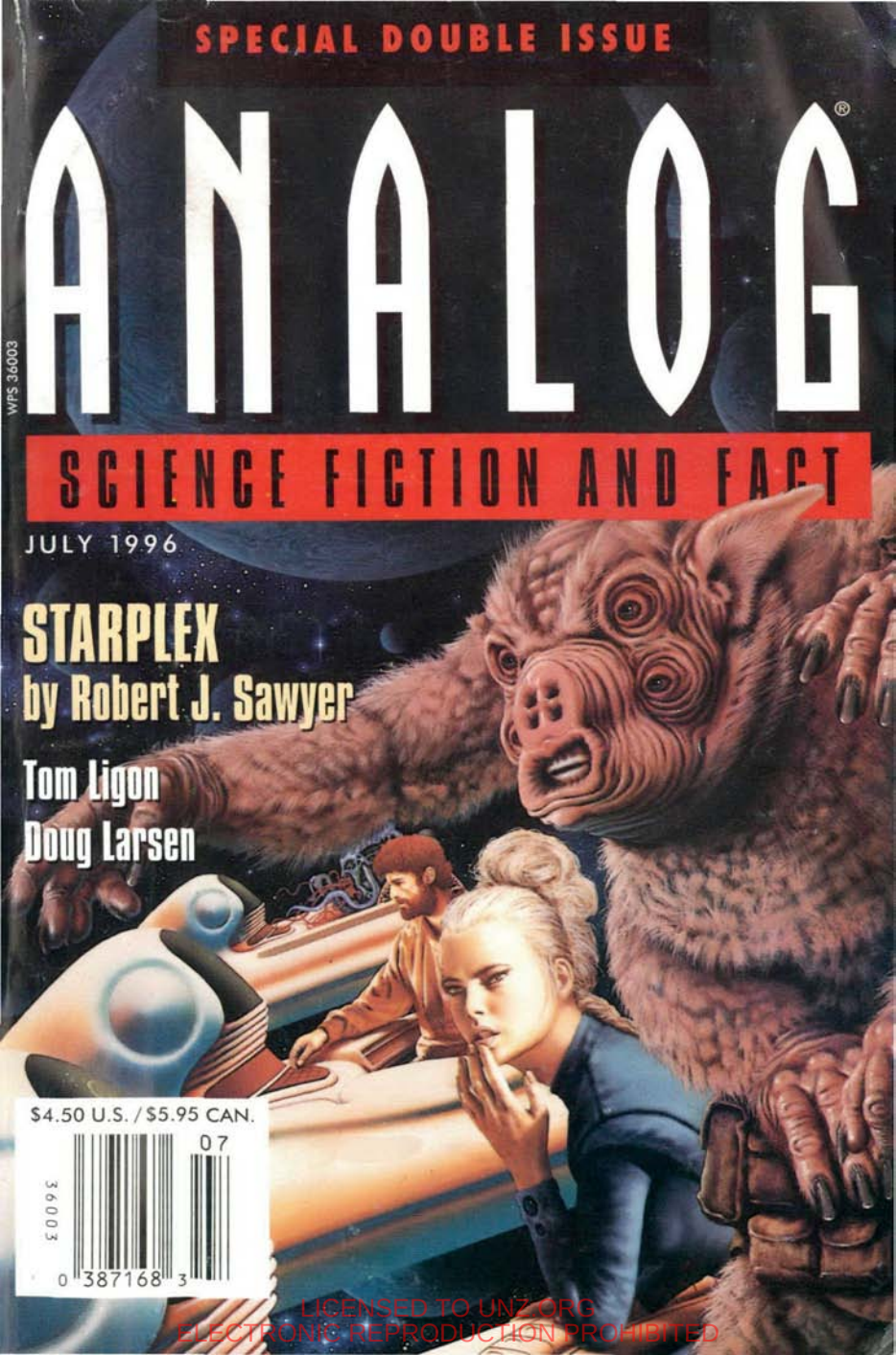

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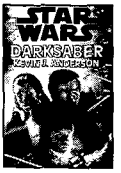

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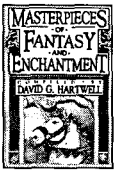

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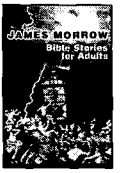

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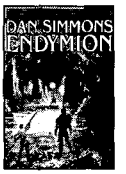

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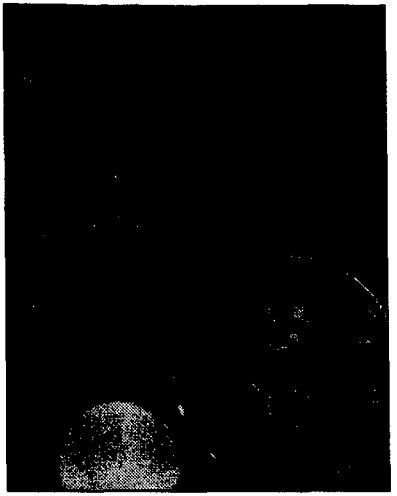

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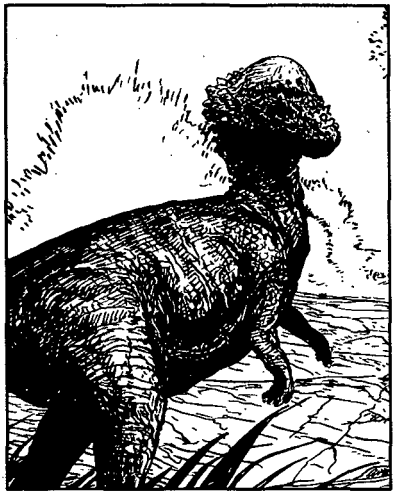

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GUEST EDITORIAL Poul Anderson

THE FUTURE OF THE FUTURE

A great deal has been written about the nature of science fiction. I'm not about to add more. Not so much has appeared about science fiction's own tomorrows, new directions in which it might go and ways in which it might evolve. Mostly we have just seen rather pompous manifestos proclaiming this or that currently fashionable set of motifs as the one and only possibility worth considering from here on out. I'm not about to add another of these, either. I'd only like to make a few remarks and suggestions from the viewpoint of one who's been involved with the field for many years. What, indeed, are some of the roads we may find ourselves taking? What could the significance be? To think about this, we shall have to glance at our past and our present. I hope that not every observation that gets made will be ridiculously obvious.

In my opinion, science fiction is not inherently different from any other literature, including the so-called mainstream. Everything worth reading or watching is basically about people and about ideas. To be sure, the emphasis and approach vary from case to case. A factor that worked to isolate science fiction for a long time, pretty much confining it to a small coterie of enthusiasts, was vocabulary.

Spaceships, extraterrestrial robots, androids, sentient machines, time machines, all such terms were once gibberish to Joe and Joanna Average. Today they're common currency, and the millionfold audience of *Star Trek* has no trouble at all. In part, this is because the things the terms refer to are more and more pushing out of imagination and into reality, when they haven't already done so. Even notions like time travel and travel faster-than-light, although they may turn out to be impossibilities, are no longer scientifically disreputable, but get serious discussion.

Another reason for the acceptance of the science fiction vocabulary among the general public is probably a sort of cultural osmosis. Science fiction was around long enough that a large enough percentage of the population got some exposure to it, maybe only briefly and when they were young, but still, there they were and there it was, ready for the time when reality started catching up.

In fact, by now most of the vocabulary in itself is a string of clichés. So is far too much published science fiction and, alas, nearly everything on

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the screens. If science fiction as a whole ever congeals into a sterile sameness, that will not only be a loss to those of us who have enjoyed it. It will be a loss to the entire world.

This may seem a pretentious claim to make, so let me try to justify it a bit. I have said before and will now say again, in its admittedly small way science fiction performs two important social services. First, in its written versions it helps keep literacy alive, the habit of reading rather than all the time staring at the tube or playing empty games. In this day and age, that is no slight thing. Second, it recruits a goodly number of the scientists and technologists we so urgently need to keep our civilization going. I have been told personally by no few such people, some of them world-famous, that science fiction was what got them hooked in their youth. By casting glamor over the subjects, it inspired them to persevere through the long, hard, unglamorous years of study and apprenticeship necessary before they could start on the real stuff.

Perhaps you are thinking that this is all very well, but those stories were in the past and you don't want to read, or write, the same material over and over. You'd like at least some of your fiction to take up new enterprises and seek themes more profound. No argument. So would I. And we do have writers who are making the effort, sometimes with splendid success.

About human, adult themes—and by "adult" I do not mean "pornographic," even though the two are often confused these days—about explorations of the human psyche, I have little to say here. They are integral to all true literature. They are by no means incompatible with science fictional concepts. We saw this years ago in the work of Theodore Sturgeon, we see it today in the work of Ursula K. Le Guin, to name only two outstanding examples. But what about those concepts themselves? We've had our spaceships, extraterrestrial robots, et cetera for a long time now. What can we do with them that is new?

Well, there is no such thing as a used-up theme. The *Iliad* did not exhaust the war story, nor did *The Red Badge of Courage*, and so on right to the present moment. Somebody like Hal Clement can still give us fresh, delightful aliens and planets. Somebody like Greg Bear or Kim Stanley Robinson can still push the envelope of col-

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onization beyond Earth. A complete list would be lengthy.

But the possibilities are larger yet. I wrote of reality as catching up with science fiction. By that I meant mundane reality, everyday life, applied science if you like. Science fiction has never been in advance of pure science. At most, a few guesses may have come somewhere near the mark—and those were guesses based on the science of the time. Basically, science fiction that really is science fiction and not glorified fantasy follows actual science, takes inspiration from it, tries to put its findings into human, experiential terms. And certainly we have no lack of such inspiration. Year by year, the visions that open up to us grow more and more surprising, more and more dazzling.

More and more weird, too. At a seminar on the subject that I recently attended, somebody said that if you think you understand quantum mechanics you're wrong, and if you do understand quantum mechanics you're crazy. Yet this branch of physics checks out to more decimal places in the laboratory than any other has ever done.

I'm not sure how science fiction can best handle it, and all the other strangenesses that science is revealing, but here we have a big and exciting challenge. Quite likely it will call for some rather radically new stylistic treatments. They'll put a lot of readers off, but that can't be helped. Pioneering has its prices, and one of those prices is apt to be loneliness. Eventually the rest of us will come into the

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territory and make ourselves familiar with it.

Cosmology, physics, and biology aren't the only fields going all peculiar on us. The ordinary world is. Look around you, and imagine you are a time traveler suddenly arrived from about 1926. (This gives us the threescore and ten years formerly quoted as a normal human lifespan.) What strikes you as outlandish?

Practically everything, of course. Never mind the funny clothes. Let's even disregard the fantastic scientific and technological developments, except insofar as they affect daily life. But what about families, the core of every society? Here divorces are easy to get, and are not regarded as tragedies. Instead, many people marry and dissolve their marriages almost as casually as they go to bed without any ceremonies. To have several children is not a blessing. Instead, overpopulation has become a major issue. In China—for heaven's sake, China—the rulers are ruthlessly trying to limit reproduction to one child per couple. The methods are less harsh but the attitude is much the same around most of the globe.

In America, schools are no longer run along the lines of maximum-security prisons and uppity adolescents are no longer slapped down. The general atmosphere is far more compassionate and tolerant. How can it be that so many kids are packing weapons to class and so few of them come out able to write an understandable sentence?

On the positive side, opportunities and encouragement that never existed before are open to women, the handicapped, and minorities. It has gone so far that people get jobs or are elected to public office not in spite of race or sex or sexual orientation, but because of it!

Governments, conspicuously including the government of the United States, have grown astronomically in size, cost, and the control they exercise over their citizens' lives. At the same time, paradoxically, the great powers are becoming more and more impotent internationally, so that the United States, for example, was defeated in war by North Vietnam and, although victorious on the battlefield against Iraq, evidently could not depose the leader of the enemy.

Once he gets over his bewilderment, perhaps our time traveler will refrain from deciding that things are either better or worse than they are where he came from. The most reasonable judgment is that in some respects there has been vast improvement, in other respects a dismaying decline. The point is simply that this world is altogether different from his.

How right Mark Twain was when he remarked that truth is always stranger than fiction because truth isn't obliged to make sense. Except for some of the technology—and it missed a lot of that—science fiction foresaw essentially nothing of the conditions under which we live today.

Well, foreseeing isn't its business. Isaac Asimov's *Foundation* stories were brilliant and seminal, but in later years he agreed that human affairs are chaotic and we never will have a Hari Seldon. Robert Heinlein had earlier

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given us a homely illustration. He pointed out that by 1900 automobiles were widely in evidence, and most people who thought about it realized they would become commonplace. But almost nobody predicted a consequent change in the focus of economic activity, a monstrous network of highways and service stations, the decay of city downtowns, and oil becoming so critical a resource that wars were fought over it. I might add parenthetically that smog without coal fires wasn't anticipated either. Then Heinlein observed that absolutely no one predicted, nor could anyone possibly have predicted, that one major thing the automobile would do was revolutionize American patterns of courtship.

Science fiction doesn't deal with the future, it deals with a quasi-infinite variety of conceivable futures. In so doing, by opening readers' minds to how enormous that realm of possibilities is, perhaps it helps them cope with the real future as it comes into being, if only by warning against some of the mistakes that can be made. John Campbell said once that the virtue of science fiction is that in it you can test a society to destruction without actually killing anybody.

Not so by the way, while it does appear that history is chaotic, this does not mean it is incomprehensible or senseless. Chaotic systems have their underlying order and their attractors. I have often declared that the lessons of history aren't hard to learn; the trouble is that very few people ever want to learn them. Some science fiction stories set certain unpalatable truths clearly forth—another service the field performs now and then.

Needless to say, we don't want dry lectures by cardboard characters. We want tales that excite and move us, tales of believable individuals whom we can care about. Some of them will be grim, if the authors are honest, but with equal honesty others can be stories of promise and cheer. And this is by no means the least service of science fiction.

While I was at a conference in Poland a few years ago, a man from Romania got up and maintained at some length that science fiction was what had kept hope and humanness alive in him and his friends throughout the dark decades of Communist rule. It held up before them the vision of a better world; it showed, in narrative form, that there is more to life than whatever surrounds us at the moment, that there is a whole Universe out yonder for life to grow into, to become free and to realize itself.

I thought at first that this was only fannish enthusiasm. But then he went on to describe the means by which science fiction was smuggled in from abroad, and those by which readers contrived to get together and talk about it. You don't risk prison or worse for a mere hobby. I ended up feeling very honored and very humble.

Now of course I do not mean to imply that science fiction must hew to any particular ideology. Taken as a whole, it never did and it never should. That would be as stultifying as confinement to any other dogma, and even more of a divorce from reality. History and anthropology alike show

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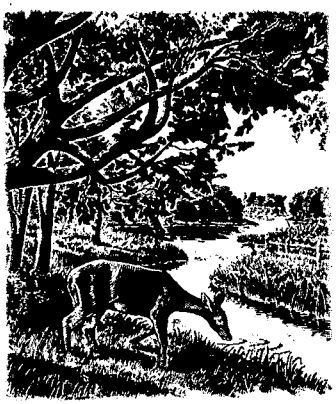
that, while some systems are intrinsically evil, human beings have lived well enough under a broad range of others. All these have had their own benefits and their own drawbacks. None has been perfect, none has lasted indefinitely, nor is any ever likely to. Surely, in the reaches of space-time ahead of us, our species will make many different adaptations, will find many different ways of life. Some of these may well be utterly unlike anything in history so far. Science fiction can try to explore a few of the possibilities and put them in terms of flesh-and-blood persons.

It is precisely this liberty to roam that is at the heart of science fiction. If it is not free, if it may not go wherever it will, it is worthless.

In the end, its ideas are what make it special. Mostly we just play with them, and that is as it should be. I've tried to suggest a few of the values in our literature, but it is, after all, like every other literature and art, a minuscule part of this wonderful cosmos we are briefly privileged to inhabit. If it helps the human adventure along a tiny bit, that is enough. Otherwise what it is, is fun.

And that is no small service either. ■



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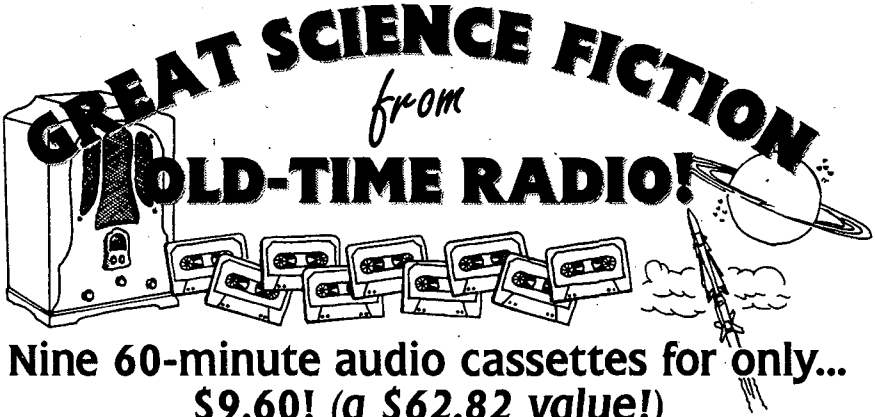

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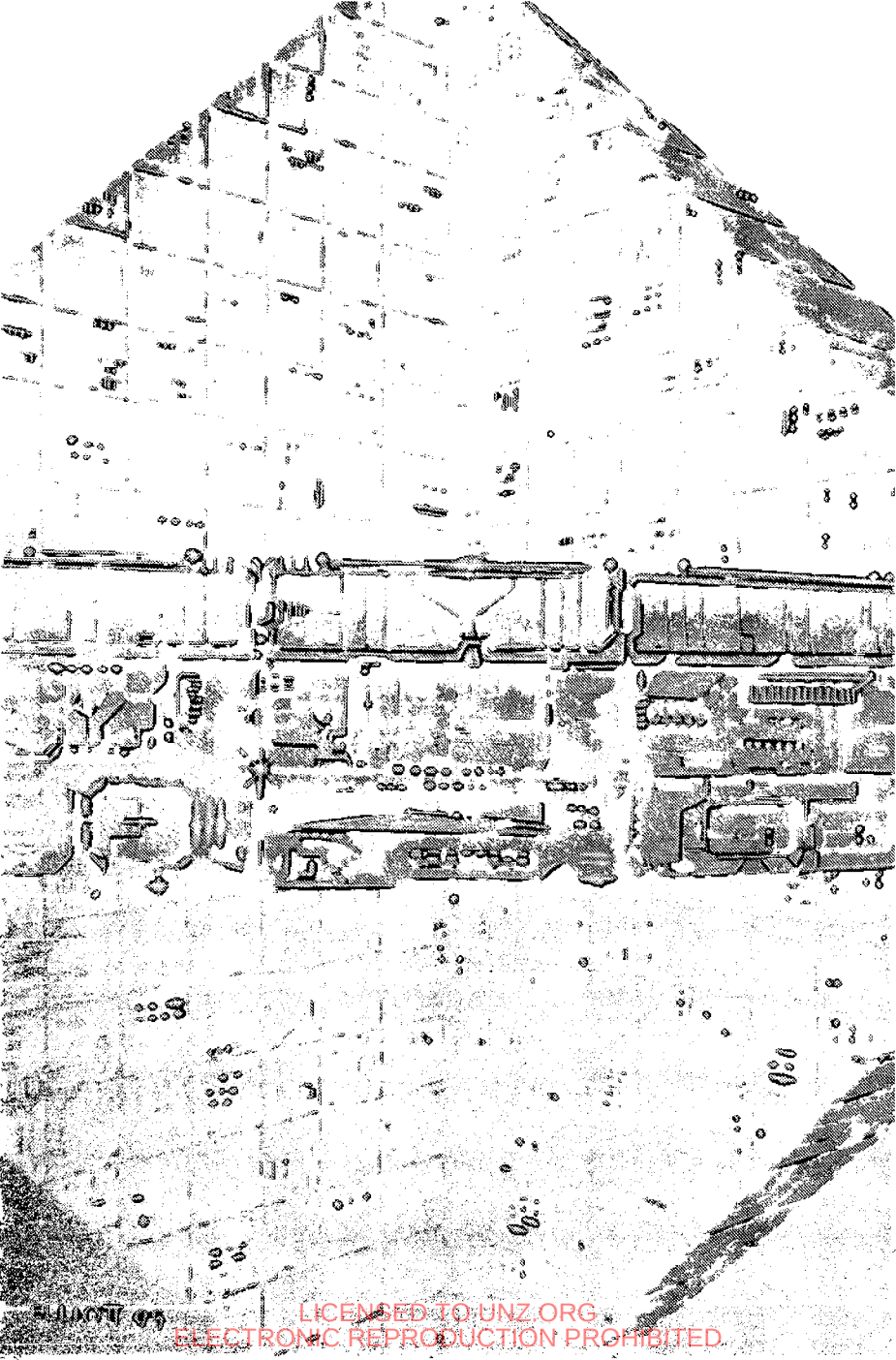

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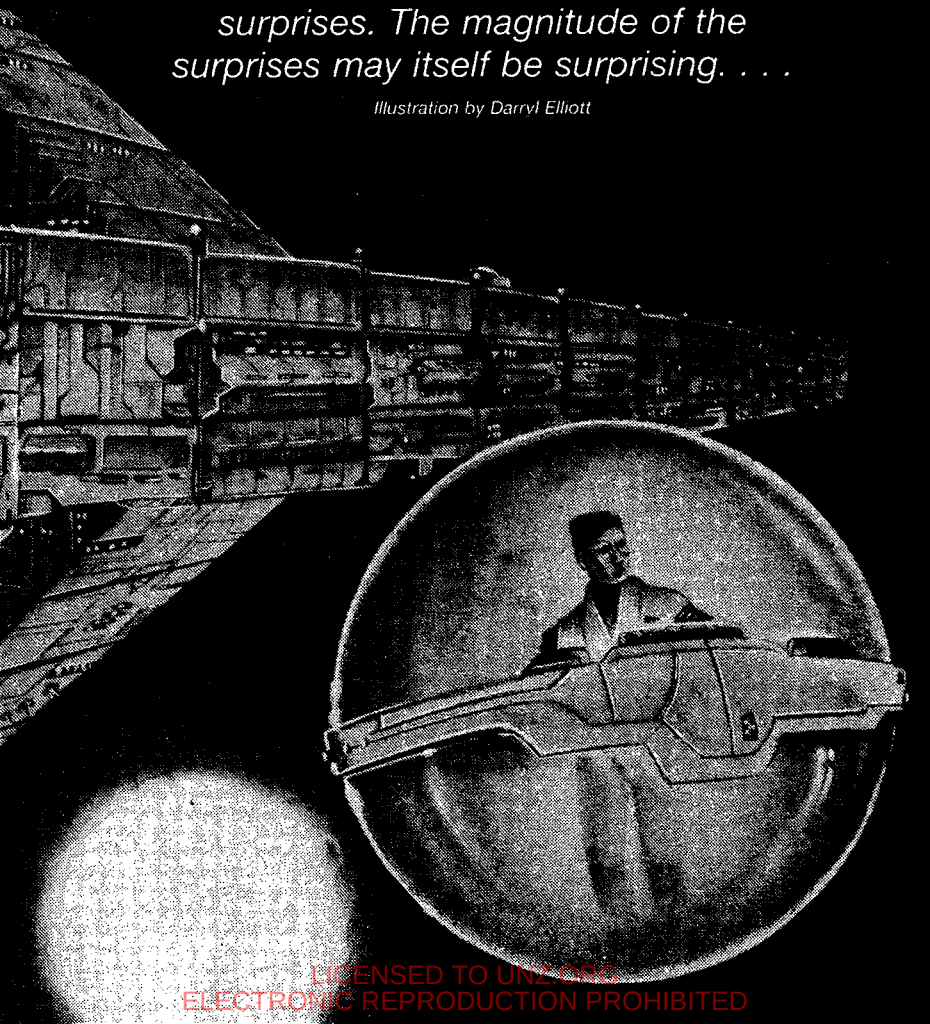
Part One of Four

Robert J. Sawyer

STARPLEX

First contact will surely be full of surprises. The magnitude of the surprises may itself be surprising. . . .

Illustration by Darryl Elliott



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PART ONE

Alpha Draconis

There would be hell to pay.

The gravity had already been bled off, and Keith Lansing was now floating in zero-g. Normally he found that experience calming, but not today. Today, he exhaled wearily and shook his head. The damage to Starplex would cost billions to repair. And how many Commonwealth citizens were dead? Well, that would come out in the eventual inquest—something he wasn't looking forward to one bit.

All the amazing things they had discovered, including first contact with the darmats, could still end up being overshadowed by politics—or even interstellar war.

Keith touched the green GO button on the console in front of him. There was a banging sound, conducted through the glassteel of the hull, as his travel pod disengaged from the access ring on the rear wall of the docking bay. The entire run was preprogrammed into the pod's computer: exiting Starplex's docks, flying over to the shortcut, entering it, exiting at the periphery of the Tau Ceti system, and moving into one of the docking bays on Grand Central, the United Nations space station that controlled traffic through the shortcut closest to Earth.

And, because it was all preprogrammed, Keith had nothing to do during the journey but reflect on everything that had happened.

He didn't appreciate it at the time, but that, in itself, was a miracle. Traveling halfway across the Galaxy in the blink of an eye had become routine. It was a far cry from the excitement of eighteen years ago, when Keith had been on hand for the discovery of the shortcut network—a vast array of apparently artificial gateways that permeated the Galaxy, allowing instantaneous point-to-point transfer. Back then, Keith had called the whole thing magic. After all, it had taken all of Earth's resources twenty years earlier to establish the New Beijing colony on Tau Ceti IV, just 11.8 light-years from Sol, and New New York on Epsilon Indi III, only 11.2 light-years away. But now humans routinely popped from one side of the Galaxy to the other.

And not just humans. Although the shortcut builders had never been found, there were other forms of intelligent life in the Milky Way, including the Waldahudin and the Ibs who, together with Earth's humans and dolphins, had established the Commonwealth of Planets eleven years ago.

Keith's pod reached the edge of docking bay twelve and moved out into space. The pod was a transparent bubble, designed to keep one person alive for a couple of hours. Around its equator was a thick white band containing life-support equipment and maneuvering thrusters. Keith turned and looked back at the mother ship he was leaving behind.

The docking bay was on the rim of Starplex's great central disk. As the pod pulled farther away, Keith could see the interlocking triangular habitat modules, four on top and four

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more on the bottom.

Christ, *thought Keith as he looked at his ship.* Jesus Christ.

The windows in the four lower habitat modules were all dark. The central disk was crisscrossed with hairline laser scorches. As his pod moved downward, he saw stars through the gaping circular hole in the disk where a cylinder ten decks thick had been carved out of it—

Hell to pay, *thought Keith again.* Bloody hell to pay.

He turned around and looked forward, out the curving bubble. He'd long ago given up scanning the heavens for any sign of a shortcut. They were invisible, infinitesimal points until something touched them, as—he glanced at his console—his pod was going to do in forty seconds. Then they swelled up to swallow whatever was coming through.

He'd be on Grand Central for perhaps eight hours, long enough to report to Premier Petra Kenyatta about the attack on Starplex. *Then he'd pop back here. Hopefully by that time, Jag and Longbottle would have news about the other big problem they were facing.*

The pod's maneuvering thrusters fired in a complex pattern. To exit the network back at Tau Ceti, he'd have to enter the local shortcut from above and behind. The stars moved as the pod modified its course to the proper angle, and then—

—And then it touched the point. Through the transparent hull, Keith saw the fiery purple discontinuity between the two sectors of space pass over the pod, mismatched starfields fore and aft. To the rear, the eerie green light of the region he was leaving, and up ahead, pink nebulosity—

Nebulosity? That can't be right. Not at Tau Ceti.

But as the pod completed its passage, there could be no doubt: he'd come out at the wrong place. A beautiful rose-colored nebula, like a splayed six-fingered hand, covered four degrees of sky. Keith wheeled around, looking out in all directions. He knew well the constellations visible from Tau Ceti—slightly skewed versions of the same ones seen from Earth, including Boötes, which contained bright Arcturus and Sol itself. But these were unfamiliar stars.

Keith felt adrenaline pumping. New sectors of space were being opened at a great rate, as new exits became valid choices on the shortcut network. Clearly, this was a shortcut that had only just come on-line, making more narrow the acceptable angles of approach to reach Tau Ceti.

No need to panic, thought Keith. He could get to his intended destination easily enough. He'd just have to re-enter the shortcut on a slightly different path, making sure he didn't vary at all from the mathematical center of the cone of acceptable angles for Grand Central Station.

Still—another new sector! That made five in the last year. God, he thought, it was too bad they'd had to cannibalize half of Starplex's *planned sister ship for parts; they could use another exploration mother ship immediately if things kept on like this.*

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Keith checked his flight recorder, making sure he'd be able to return to this place. The instruments seemed to be operating perfectly. His first instinct was to explore, discovering whatever this new sector had to offer, but a travel pod was designed only for quick journeys through shortcuts. Besides, Keith had a meeting to get to and—he glanced at his watch implant—only forty-five minutes before it would begin. He looked down at his control panel and keyed in instructions for another pass through the shortcut network. He then checked the settings that had brought him here—and frowned. Why, he had *come through at precisely the right angle for Tau Ceti. He'd never heard of a shortcut transfer going wrong before, but. . . .*

When he looked up, the starship was there.

It was shaped like a dragon, with a long, serpentine central hull and vast swept-back extensions that looked like wings. The entire thing consisted of curves and smooth edges, and there was no detailing on its robin's-egg-blue surface, no sign of seams or windows or vents, no obvious engines. The whole thing must have been glowing, since there were no stars nearby to illuminate it, and no shadows fell across any part of its surface. Keith had thought Starplex *beautiful before its recent battle scars, but it had still always seemed manufactured and functional. This alien ship, though, was* art.

The dragon ship was moving directly toward Keith's pod. The readout on his console said it was almost a kilometer long. Keith grabbed the pod's joystick, wanting to get out of the approaching ship's path, but suddenly the dragon came to a dead stop relative to the pod, fifty meters ahead.

Keith's heart was pounding. Whenever a new shortcut came online, Starplex*'s first job was to look for any signs of whatever intelligence had activated the shortcut by passing through it for the first time. But here, in a one-person travel pod, he lacked the signaling equipment and computing power needed to even attempt communications.*

Besides, there had been no sign of the ship when he'd surveyed the sky moments ago. Any vessel that could move that quickly then stop dead in space had to be the product of very advanced technology. Keith was in over his head. He needed if not all of Starplex*, at least one of the diplomatic craft it carried in its docking bays. He tapped the key that should have started his pod back toward the shortcut.*

But nothing happened. No—that wasn't quite right. Craning his neck, Keith could see his pod's maneuvering thrusters firing on the outside of the ring around the habitat bubble. And yet the pod wasn't moving at all; the background stars were rock steady. Something had to be holding him in place, but if it was a tractor beam, it was the gentlest one he'd ever encountered. A travel pod was fragile; a conventional tractor would have made its glassteel hull groan at the seams.

Keith looked again at the beauti-

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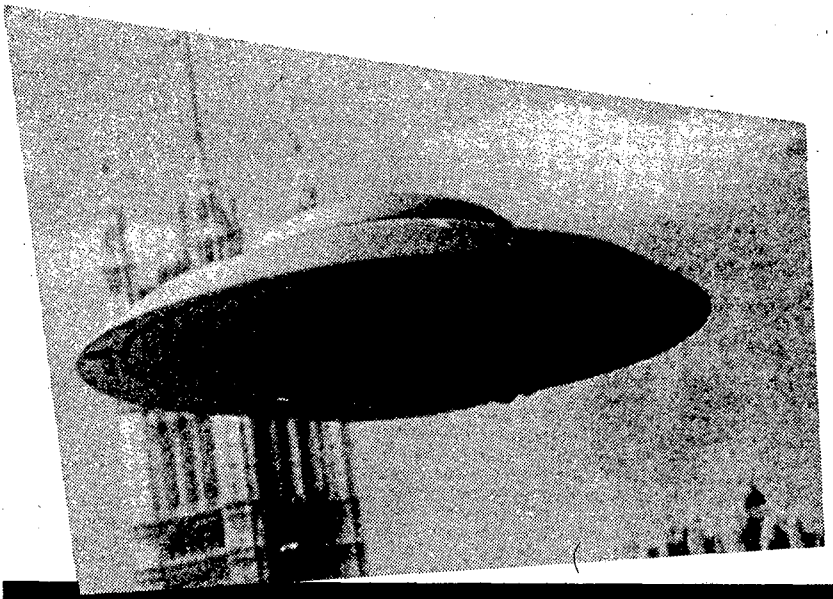

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ful ship, and as he watched a—a docking bay, it must have been—appeared in its side, beneath one of the curving wings. There had been no sign of a space door moving away to reveal it. The opening simply wasn't there one instant, and the next instant, it was—a cube-shaped hollow in the belly of the dragon. Keith found his pod moving now in the opposite direction he was telling it to go, moving toward the alien vessel.

Despite himself, he was starting to panic. He was all in favor of first contact, but preferred it on more equal terms. Besides, he had a wife to get back to, a son away at university, a life he very much wanted to continue living.

The pod floated into the bay, and Keith saw a wall wink into existence behind him, closing the cube off from space. The interior was lit from all six sides. The pod was presumably still being held by the tractor beam—no one would pull an object inside just to let it crash into the far wall under its own inertia. But nowhere could Keith see a beam emitter.

As the pod continued its journey, Keith tried to think rationally. He had entered the shortcut at the right angle to come out at Tau Ceti; no mistake had been made. And yet, somehow, he had been—been diverted *here. . . .*

Which meant that whoever controlled this interstellar dragon knew more about the shortcuts than the Commonwealth races did.

And then it hit him.

The realization.

The horrible realization.

Time to pay the toll.

CHAPTER 1

It had been like a gift from the gods: the discovery that the Milky Way Galaxy was permeated by a vast network of artificial shortcuts that allowed for instantaneous journeys between star systems. No one knew who had built the shortcuts, or what their exact purpose was. Whatever hugely advanced race created them had left no other trace of its existence.

Scans made by hyperspace telescopes suggested that there were four *billion* separate shortcut exits in our Galaxy, or roughly one for every hundred stars. The shortcuts were easy to spot in hyperspace: each one was surrounded by a distinctive sphere of orbiting tachyons. But of all those shortcuts, only two dozen appeared to be active. The others clearly existed, but there seemed to be no way to move to them.

The closest shortcut to Earth was in the Oort cloud of Tau Ceti. Through it, ships could jump 70,000 light-years to Rehbollo, the Waldahud homeworld. Or they could jump 53,000 light-years to Flatland, home of the bizarre Ib race. But the shortcut exit that existed near Polaris, for instance, just 800 light-years away, was inaccessible. It, like almost all the others, was dormant.

A particular shortcut would not work as an *exit* for ships arriving from other shortcuts until it had first been used locally as an *entrance*. Thus, the Tau Ceti shortcut had not been a valid

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exit choice for other races until the UN sent a probe through it, eighteen years ago, back in 2076. Three weeks later, a Waldahud starship popped out of that same shortcut—and suddenly humans and dolphins were not alone.

Many speculated that this was how the shortcut network had been designed to work: sectors of the Galaxy were quarantined until at least one race within them had reached technological maturity. Given how few shortcuts were active, some argued that Earth's two sentient species, *Homo sapiens* and *Tursiops truncatus*, were therefore among the first races in the Galaxy to reach that level.

The next year, ships from the Ib homeworld popped through at Tau Ceti and near Rehbollo—and soon the four races agreed to an experimental alliance, dubbed the Commonwealth of Planets.

In order to expand the usable shortcut network, seventeen years ago each homeworld launched thirty *boomerangs*. Each of these probes flew at their maximum hyperdrive velocity—twenty-two times the speed of light—toward dormant shortcuts that had been detected by their tachyon coronas. Upon arrival, each boomerang would dive through and return home, thus activating the shortcut as a valid exit.

So far, boomerangs had reached twenty-one additional shortcuts within a radius of 375 light-years from one or another of the three homeworlds. Originally, these sectors were explored by small ships. But the Commonwealth had realized a more comprehensive solution was needed: a giant mother ship from which exploration surveys could be launched, a ship that could serve not only as a research base during the crucial initial exploration of a new sector, but also could function as embassy for the Commonwealth, if need be. A vast starship capable of not just astronomical research, but of undertaking first-contact missions as well.

And so, a year ago, in 2093, *Starplex* was launched. Funded by all three homeworlds and constructed at the Rehbollo orbital shipyards, it was the largest vessel ever built by any of the Commonwealth races: 290 meters at its widest point, seventy decks thick, a total enclosed volume of 3.1 million cubic meters, outfitted with a crew of a thousand beings and fifty-four small auxiliary ships of various designs.

Starplex was currently 368 light-years due galactic south of Flatland, exploring the vicinity of a recently activated shortcut. The closest star was an F-class subgiant a quarter-light-year away. It was surrounded by four asteroid belts, but no planets. An uneventful mission so far—nothing remarkable astronomically, and no alien radio signals detected. *Starplex*'s staff was busy winding down its explorations. In seven days, another boomerang was due to reach its designated shortcut target, this one 376 light-years away from Rehbollo. *Starplex*'s next scheduled assignment was to investigate that sector.

Everything seemed so peaceful, until—

"Lansing, you will hear me out."

Keith Lansing stopped walking

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down the cold corridor, sighed, and rubbed his temples. Jag's untranslated voice sounded like a dog barking, with occasional hisses and snarls thrown in for good measure. His translated voice—rendered in an old-fashioned Brooklyn accent—wasn't much better: harsh, sharp, nasty.

"What is it, Jag?"

"The apportioning of resources aboard *Starplex*," barked the being, "is all wrong—and you are to blame for that. Before we move to the next shortcut, I demand you rectify this. You consistently shortchange the physics division and give preferential treatment to life sciences."

Jag was a Waldahud, a shaggy piglike creature with six limbs. After the last ice age ended on Rehbollo, the polar caps had melted, flooding much of the land and crisscrossing what remained with rivers. The Waldahudin's ancestors adapted to a semi-aquatic lifestyle, their bodies becoming well-insulated with fat overlain by brown fur to keep out the chill of the river waters they lived in. Keith took a deep breath and looked at Jag. *He's an alien, remember. Different ways, different manners.* He tried to keep his tone even. "I don't think that's quite fair."

More dog barks. "You give special treatment to life sciences because your spouse heads that division."

Keith forced a small laugh, although his heart was pounding with repressed anger. "Rissa sometimes says the opposite—that I don't give her enough resources, that I'm bending over backwards to appease you."

"She manipulates you, Lansing. She—what is the human metaphor? She has you wrapped around her little finger."

Keith thought about showing Jag a different finger. They're all like this, he thought. An entire planet of quarrelsome, bickering, argumentative pigs. He tried not to sound weary. "What exactly is it that you want, Jag?"

The Waldahud raised his upper left hand, and ticked off stubby, hairy fingers with his upper right. "Two more probeships assigned exclusively to physical-sciences missions. An additional Central Computer bank dedicated to astrophysics. Twenty more staff members."

"The staff additions are impossible," said Keith. "We don't have apartments to house them. I'll see what I can do about your other requests, though." He paused for a second, and then: "But in future, Jag, I think you'll find that I'm easier to convince when you don't bring my private life into the discussion."

Jag barked harshly. "I knew it!" said the translated voice. "You make your decisions based on personal feelings, not on the merit of the argument. You are truly unfit to hold the post of director."

Keith felt his anger about to boil over. He tried to calm himself, and closed his eyes, hoping to summon a tranquil image. He expected to see his wife's face, but the picture that came to him was of an Asian beauty two decades younger than Rissa—and that just made Keith madder at himself. He opened his eyes. "Look," he said, a quaver in his voice, "I don't give a

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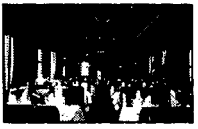

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damn whether you approve of the choice of me as *Starplex* director or not. The fact is that I *am* director, and will be for another three years. Even if you could somehow get me replaced before my term is over, the agreed-to rotation calls for a human to hold this post at this time. If you get rid of me—or if I quit because I'm fed the hell up with you—you're still going to be reporting to a human. And some of us don't like you—" he stopped himself before he said *you pigs*—"at all."

"Your posturing does you no credit, Lansing. The resources I am demanding are for the good of our mission."

Keith sighed again. He was getting too old for this. "I'm not going to argue anymore, Jag. You've made your request; I'll give it all the consideration it is due."

The Waldahud's four square nostrils flared. "I am amazed," said Jag, "that Queen Trath ever thought we could work with humans." He rotated on his black hooves, and headed down the corridor without another word. Keith stood there for two minutes, doing calming breathing exercises, then headed along the chilly corridor toward the elevator station.

Keith Lansing and his wife, Rissa Cervantes, shared a standard human apartment aboard *Starplex*: L-shaped living room, a bedroom, a small office with two desks, one bathroom with human fixtures, and a second with multi-species fixtures. There was no kitchen, but Keith, who liked to cook, had rigged up a small oven so that he could indulge his hobby.

The main door to the apartment slid open, and Keith stormed in. Rissa must have arrived a few minutes earlier; she came out of the bedroom naked, obviously preparing for her midday shower.

"Hi, Chesterton," she said, smiling. But the smile faded away, and Keith imagined that she could see the tension in his face, his forehead creased, his mouth downturned. "What's wrong?"

Keith flopped himself onto the couch. From this angle, he was facing the dart board Rissa had mounted on one wall. The three darts were clustered in the tiny sixty-point part of the triple-scoring band—Rissa was shipboard champion. "Another run-in with Jag," said Keith.

Rissa nodded. "It's his way," she said. "It's their way."

"I know. I know. But, Christ, it's hard to take sometimes."

They had a large real window on one wall, showing the starfield outside the ship, dominated by the bright F-class star nearby. Two other walls were capable of displaying holograms. Keith was from Calgary, Alberta; Rissa had been born in Spain. One wall showed glacier-fed Lake Louise, with the glorious Canadian Rockies rising up behind it; the other a long view of downtown Madrid, with its appealing mixture of sixteenth- and twenty-first century architecture.

"I thought you'd show up here around now," said Rissa. "I was waiting to shower with you." Keith was pleasantly surprised. They'd showered together a lot when they'd first gotten married, almost twenty years ago, but had gotten out of the habit as

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the years wore on. The necessity of showering twice a day to minimize the human body odor Waldahudin found so offensive had turned the cleansing ritual into an irritating bore, but maybe their impending anniversary had Rissa feeling more romantic than usual.

Keith smiled at her and began to undress. Rissa headed into the main bathroom and began running the water. *Starplex* was such a contrast to the ships of Keith's youth, like the *Lester B. Pearson* he'd traveled on back when first contact with the Waldahudin had been made. In those days, he'd had to be content with sonic showers. There was something to be said for carrying a miniature ocean around as part of your ship.

He followed her into the bathroom. She was already in the shower, soaking down her long, black hair. Once she'd moved out from under the shower head, Keith jockeyed into position, enjoying the sensation of her wet body sliding past his. He'd lost half his hair over the years, and what was left he kept short. Still, he massaged his scalp vigorously, trying to work out his anger with Jag in doing so.

He scrubbed Rissa's back for her, and she scrubbed his in turn. They rinsed, then he turned off the water. If he hadn't been so angry, perhaps they'd have made love, but. . . .

Dammit. He began to towel off.

"I hate this," Keith said.

Rissa nodded. "I know."

"It's not that I hate Jag—not really. I hate . . . hate myself. Hate feeling like a bigot." He ran the towel up and down his back. "I mean, I know the Waldahudin have different ways. I *know* that, and I try to accept it. But—Christ, I hate myself for even thinking this—they're all the same. Obnoxious, argumentative, pushy. I've never met one who wasn't." He sprayed deodorant under each arm. "The whole idea of thinking I know all about somebody just because I know what race they belong to is abhorrent—it's everything I was brought up to fight against. And now I find myself doing it day in and day out." He sighed. "Waldahud. Pig. The terms are interchangeable in my mind."

Rissa had finished drying herself. She pulled on a beige long-sleeve shirt and fresh panties. "They think the same way about us, you know. All humans are weak, indecisive. They don't have any *korbaydin*."

Keith managed a small laugh at the use of the Waldahudar word. "I do, too," he said pointing down. "Of course, I only have two instead of four, but they do the job." He got a fresh pair of boxer shorts and a pair of brown denim pants out of the closet, and put them on. The pants constricted to fit around his waist. "Still," he said, "the fact that they also generalize doesn't make it any better." He sighed. "It wasn't like this with the dolphins."

"Dolphins are different," said Rissa, pulling on a pair of red pants. "In fact, maybe that's the key. They're so different from us that we can bask in those differences. The biggest problem with the Waldahudin is that we have too much in common with them."

She moved over to her dresser. She

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didn't put on any makeup; the natural look was the current style for both men and women. But she did insert two diamond earrings, each the size of a small grape. Cheap diamond imports from Rehbollo had destroyed any remaining value natural gemstones had, but their innate beauty was unsurpassed.

Keith had finished dressing, too. He'd put on a synthetic shirt with a dark brown herringbone pattern, and a beige cardigan sweater. Thankfully, as humanity moved out into the Universe, one of the first bits of needless mass to be ejected had been the jacket and tie for men; even formal wear did not demand them anymore. With the advent of the four-day, and then the three-day, workweek on Earth, the distinction between office clothes and leisure clothes had disappeared.

He looked over at Rissa. She *was* beautiful—at forty-four, she was still beautiful. Maybe they *should* make love. So what if they just got dressed? Besides, these crazy thoughts about—

Bleep. "Karendaughter to Lansing."

Speak of the devil. Keith lifted his head, spoke into the air. "Open. Yes?"

Lianne Karendaughter's rich voice came out of the wall speaker. "Keith—fantastic news! A watson just came through from CHAT with word that a new shortcut has come on-line!"

Keith raised his eyebrows. "Did the boomerang reach Rehbollo 376A ahead of schedule?" That sometimes happened; judging interstellar distances was a tricky game.

"No. This is a *different* shortcut, and it came on-line because something—or, if we're lucky, *someone*—moved through it locally."

"Has anything unexpected come through any of the homeworld shortcuts?"

"Not yet," said Lianne, her voice still bubbling with excitement. "We only discovered this one was now on-line because a cargo module accidentally got misdirected to it."

Keith was on his feet at once. "Recall all probeships," he said. "Summon Jag to the bridge, and alert all stations for a possible first-contact situation." He hurried out the apartment door, Rissa right behind him.

Beta Draconis

Keith Lansing looked around the docking bay aboard the strange alien craft. Like the ship's exterior, this part, too, was featureless. No seams, no equipment, nothing marring the six glowing cube faces.

When the shortcuts were discovered, the press had delighted in bandying around a century-old saying, attributed to the Sri Lankan writer Arthur C. Clarke: "Any sufficiently advanced technology is indistinguishable from magic."

The shortcuts were magic.

And so was this strange, beautiful starship, this starship that moved in apparent defiance of Newton's laws. . . .

Keith took a deep breath. He knew what was about to happen, knew it in his bones. He was about to meet the makers of the shortcuts.

The pod's course across the bay curved gently downward and soon it came to rest on the flat lower face of the bay. Keith felt weight returning. It continued to grow slowly, and he

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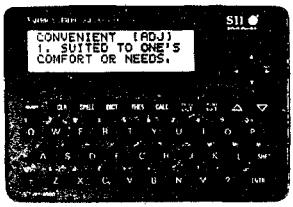

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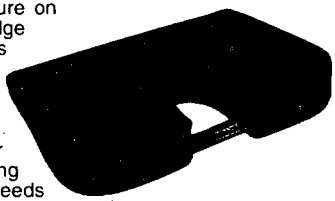

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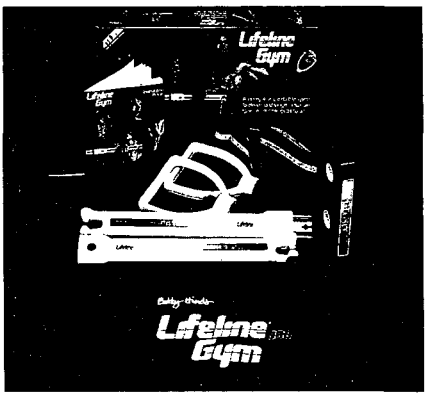

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settled to the floor. The gravity kept increasing, more and more, until it had reached Starplex*'s shipboard standard. But still it grew, and Keith fought a wave of panic, fearing he would be crushed to jelly.*

Finally, though, it stopped—and Keith realized that it was at just about the level he kept it at in his cabin aboard ship, 9 percent higher than the Commonwealth standard but equal to Earth's sea-level surface gravity.

And then, suddenly—

Everything around him was . . . was familiar.

Was Earth.

The edge of a mixed forest, maple trees and spruces rising to a sky the shade of blue like no other planet he'd ever seen. Sunlight precisely the color of Sol's—matching the anti-homesickness lamps he and Rissa had in their apartment aboard Starplex. *To his right, a lake covered with lily pads, bulrushes rising from its edge. Overhead, a V-shaped flock of—no mistake—of Canada geese, and—yup, just to dispel any final doubt, a daytime gibbous Moon, showing the Sea of Tranquillity and the O-shaped Sea of Crises to its right.*

An illusion, of course. Virtual reality. Make him feel at home. Perhaps they could read his mind, or perhaps they'd already contacted other travelers from Earth.

The travel pod had no elaborate sensors. There was air in the bay, though. He could hear—God, he could hear crickets, and bullfrogs, and, yes, the haunting call of a loon, all transmitted through the hull of the ship from the air outside. No way to test a sample, but they couldn't have gotten all the other details right and screwed up on something as simple as the gas mixture for human-breathable air.

And yet, he hesitated. The trip to Tau Ceti was supposed to be a simple run; Keith hadn't even bothered to see if there was a spacesuit in the pod's emergency locker before departure.

But it was clearly an invitation—an invitation to first contact. And first contact was what Starplex *was all about. Keith touched a series of controls, overriding the safety interlocks that kept the pod's rear door from opening when it wasn't connected to an access ring. The glassteel panel slid up into the roof.*

Keith took a tentative breath—

And sneezed.

Jesus Christ, he thought. Ragweed pollen. These guys were good.

He sniffed again, and could smell all the things he'd have smelled if he really were back on Earth. Wildflowers and grass and damp wood and a thousand other things, subtly mixed. He stepped out.

They'd thought of everything—a perfect recreation. Why, he even left footprints in the soft earth, something most virtual-reality simulations tripped up on. Indeed, he could feel the texture of the ground through the soles of his shoes, feel it give with each step, feel the springiness of grass compressing beneath his feet, the sharp jab of a stone. It was perfect. . . .

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And then it hit him. Maybe he was back on Earth. The shortcut makers knew how to cut across space in the twinkling of an eye. Maybe this was the real thing, maybe he was home—

But there had been no second shortcut inside the docking bay, no flash of purple Soderstrom radiation. And besides, if this was Earth, where had they found such unspoiled wilderness? He looked again at the sky, searching for an airplane or shuttle contrail.

Still—his sneezing meant they'd actually manufactured allergen molecules, or were manipulating his mind on a very sophisticated level. Suddenly Keith felt his throat constricting. A zoo! A goddamned zoo, and he was a specimen in it. He was trapped, a prisoner. He turned around, about to rush back to his pod, and saw the glass man.

"Hello, Keith," said the man. His whole body was transparent, made of perfect crystal that flowed as he moved. There was only the faintest hint of color to the transparent form, a touch of cool aquamarine.

Keith said nothing for several seconds. The pounding of his heart was drowning out the wilderness sounds. "You know who I am?" he said at last.

"Sort of," said the glass man. His voice was masculine, deep. His body, although humanoid, was stylized, like a mannequin in a trendy store. His head was a featureless egg-shape, with the point forming the chin. Although the arms and legs seemed well-proportioned, they were smooth, without any apparent musculature. The belly and chest were flat, and the transparent sex organ between the legs was simplified, rocket-shaped.

Keith stared at the glass man, wondering what to do next. Finally, desperate to know his status, he said: "I want to leave."

"You may," said the glass man, spreading his transparent arms. "Any time you wish. Your pod stands waiting for you." There was no sign of a speaking orifice on the simple ovoid head, but Keith's ears told him the sound was indeed emanating from it.

"This—this isn't a zoo?" asked Keith.

There was a sound like wind chimes—glassy laughter? "No."

"And I'm not a prisoner?"

The wind chimes again. "No. You are—is 'guest' the right word? You are my guest."

"How can you speak English?"

"I don't, actually, of course. My reckoner is translating the words for you."

"Did you make the shortcuts?"

"The what?"

"The shortcuts. The interstellar gateways, the stargates—whatever you want to call them."

" 'Shortcuts,' " said the glass man, nodding. "A good name for them. Yes, we created them."

Keith's pulse was racing. "What do you want from me?"

The wind chimes once more. "You seem defensive, Keith. Isn't there some standard speech you're supposed to make in a first-contact situation? Or is it too early for that?"

Too early? "Well, yes." Keith swal-

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lowed. "I, G. K. Lansing, Director of Starplex, *bring you friendly greetings from the Commonwealth of Planets, a peaceful association of four sentient races from three different homeworlds."*

"Ah, now that's better. Thank you."

Keith was struggling to take it all in: the transparent humanoid, the forest recreation, the beautiful starship, the diverting of his pod. "I'd still like to know what you want from me," he said at last.

The glass man tipped his featureless head at Keith. "Well, at the risk of sounding melodramatic, the fate of the Universe is in question."

Keith blinked.

"But, more than that," said the glass man, "I need to ask you some questions. For you see, Keith Lansing, you hold not only the key to the future, but also to the past."

CHAPTER 2

A new sector of space—and one that had opened unexpectedly. Keith and Rissa hurried to the bridge, entering through the port-side door, which meant that Keith had to pass right by Lianne Karendaughter. Brilliant (a masters in electrical engineering from MIT), beautiful (luscious Asian features, mounds of platinum hair pinned up by gold clips), and young, Lianne had joined *Starplex* just six weeks ago, after a distinguished term as chief engineer on a large commercial hyperliner. She smiled at Keith as he passed—a radiant smile, a supernova smile. Keith felt his stomach flutter.

Starplex's bridge appeared to have no walls, floor, or ceiling. Instead, it was enveloped by a spherical hologram of the ship's surroundings, its workstations seemingly floating amongst the stars. The actual room was rectangular, with a doorway built into each wall, but the doors were invisible, lost within the spacescape. When they split down the middle and slid aside, it was as though space were opening up, revealing the corridors beyond. Apparently suspended in midair—but really attached to the invisible walls just above the doors—were trios of glowing clocks in each homeworld's timekeeping system.

Keith and Rissa hurried to their workstations, looking as though they were running in space.

The bridge workstations were laid out in two rows of three, with the director's position in the middle of the back row. The front row was constantly occupied. The rear stations were only used when necessary; Jag, Keith, and Rissa all had separate offices where they did most of their work. By default, one of Keith's monitors showed a chart of who was currently authorized to use each bridge station. It was the standard alpha-shift team in the front row.

The InOps manager was responsible for all on-board activities, including engineering. On the opposite side of the room was her opposite number, the ExOps manager, who supervised the docking bays and missions conducted by the fifty-four assorted ships stored there. To Keith's left was the station for Jag, head of physical sciences. To his right, again an opposite number: Rissa, head of life sciences.

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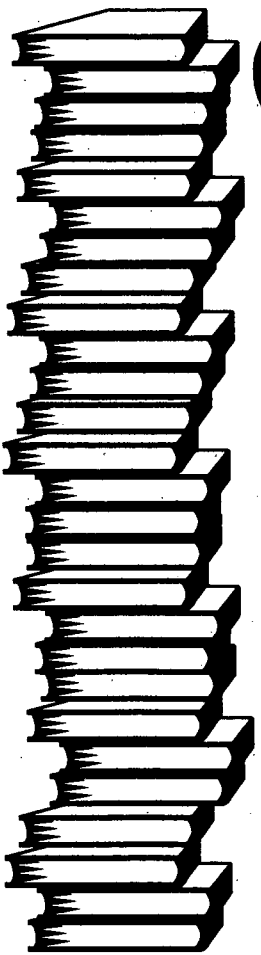

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Since most physics research was conducted aboard ship, it made sense that InOps was in front of the physics station. Lianne could swivel her chair around, or rotate the workstation on its turntable base, for face-to-face consultations with Jag. Likewise, most life-sciences work was done away from the mother ship; Rhombus at ExOps could easily consult with Rissa (although being an Ib, Rhombus had 360-degree vision; he didn't have to turn around to see her).

To make communication even easier, ten-centimeter-high real-time holograms of Lianne's and Thor's heads, plus a full body shot of Rhombus, normally floated above the rim of Jag's, Keith's and Rissa's consoles; those in the front row had holos of the back-row heads floating above their stations.

On each side of the room was a large pool covered by an anti-splash forcefield; any of the workstations could have its functions transferred to a dolphin in either pool. Behind the workstations was a row of nine polychairs for observers.

Keith watched as Jag entered through the starboard door. The Waldahud moved across the starfield, squat bow legs carrying him in short steps, four arms stiff at his sides. Jag wore a couple of functional pieces of clothing, including a belt with storage pouches depending from it, and a band with a pocket on it around his upper left arm. The damned thing was practically naked except for his thick fur while Keith was freezing to death. The ship's common areas were kept at 15 degrees Celsius, equivalent to a hot summer's noon on Rehbollo. Keith half-expected to see his breath whenever he left his apartment.

As Jag sat down, the Waldahud's monitor screens configured themselves to be twice as tall as they were wide. Jag could watch two of them simultaneously, one with his vertically stacked left pair of eyes, the other with his vertically stacked right pair. Like humans, Waldahudin had two-sided brains, but each of their hemispheres could process a separate stereoscopic image.

There was no flicker of expression on Jag's face—not that Keith was good at decoding such things, anyway. Their altercation in the corridor an hour ago merited no comment, apparently. Of course not, thought Keith. Just business as usual for one of them.

He shook his head, and turned away. Thorald Magnor, at the helm station, was a giant human of about fifty, with a fiery red beard. At ExOps, the polychair had been retracted beneath the floor, and the console lowered on its slim legs to accommodate its current user. Rhombus, like all Ibs, re-

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sembled a stone wheelchair with a watermelon in the seat.

One of Keith's monitors was already showing the report from CHAT—the Commonwealth Hyperspace Astrophysics Telescope—about the newly activated shortcut. The exit was in the Perseus Arm, some ninety thousand light-years from their current location. And that was all that was known about it, except that something had recently gone through this shortcut, activating it. What that something was, and where it had gone through the network, was anyone's guess.

"All right, everyone," said Keith. "We'll start with a standard alpha-class probe. Thor, move us to within twenty klicks of the shortcut."

"Give me two seconds, boss," said Thor. Keith could simultaneously see Thor's face in the miniature hologram, and the back of his real head at the station in front of his. His face was large and rough, his beard and hair long and wild. Keith had seen a Viking helmet on a shelf in Thor's shipboard apartment once; it would have suited him. "We've got a probeship in the process of docking."

A moment later, lights flashed on Rhombus's sensor web. "I announce with pleasure that the *Marc Garneau* is secured in docking bay eight," said a voice with a British accent in Keith's ear. By convention, Waldahud voices were translated into English with old-fashioned New York accents, while the Ibs were assigned British ones—it made it easier to sort out who was speaking, since the translated voices all came from the same source, the listener's cochlear implant.

"OK, boss," said Thor. "Here we go." In front of him, Keith could see Thor's large hands manipulating controls. The starfield surrounding the bridge began to shift. About five minutes later, the stars stopped moving again. "As requested, boss," said Thor. "Twenty thousand meters from the shortcut, on the button."

"Thank you," said Keith. "Rhombus, please launch the probe."

Rhombus's ropelike tentacles snapped across his console as if he were whipping it into submission. His sensor web flashed. "A pleasure to do so."

A schematic of the probe appeared on one of Keith's monitors: a silver cylinder, four meters long by one in diameter, its surface studded with scanners, sensors, camera lenses, and CCD plates. The probe had only thruster power and four clusters of conical attitude-control jets; a hyperdrive engine was far too expensive to risk, given that the probe might never come back.

The probe accelerated through a mass-driver tube in one of *Starplex*'s upper habitat modules. As soon as the probe was out in space, the bridge staff could see the glow of its thrusters in the holographic sphere surrounding them. The probe rotated along its axis so that each of its instruments would be exposed to the entire panorama of the sky.

There was no visible target for the probe—at least, not yet. But its course had been computed so that it would enter the shortcut at the exact angle specified by CHAT. When it did so,

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the probe seemed to disappear, a tiny ring of violet fire swallowing it up.

"In friendship I observe that passage through the shortcut was normal," reported Rhombus in his rich Oxford tones.

And now the waiting began. Each person showed tension in a different way. Lianne at InOps drummed her painted fingernails on the edge of her console. The lights on Rhombus's web flashed randomly—not a coherent pictogram, but just a sign of mental agitation. Jag picked at his fur and slid his translucent dental plates across each other, making a faint chalk-on-slate sound. Keith got up and paced. Rissa busied herself organizing files on her computer. Only the unflappable Thorald Magnor seemed calm, swinging his giant feet onto his console, and leaning back in his chair, hands interlaced behind his orange mane.

But despite Thor's appearance, there was reason for concern. Ten years ago, a boomerang launched from Tau Ceti had reached its target, a dormant shortcut near the M3-class star Tejat Posterior in the constellation Gemini. That boomerang never returned to Tau Ceti. Instead, at about the time it was supposed to come home, a smooth ball of metal shot out of the Rehbollo shortcut. Analysis determined that the ball was the remains of the probe after some process had briefly broken all molecular bonds in its construction.

The word "process" had been deliberately chosen for the public reports, but many believed that no natural activity could have done that, not even if the Tejat Posterior shortcut exit had been inside a star's core. The hypothetical beings responsible were dubbed "Slammers," because they'd apparently slammed the interstellar doorway in the Commonwealth's collective face.

Additional hyperspace probes with heavy shielding had been sent toward Tejat Posterior (from launch points well away from any of the Commonwealth homeworlds), but it would still be another two years before they arrived there. Until they did, the mystery of the Slammers remained unresolved—but there was always a fear that they might be lurking behind other shortcuts.

"With relief, I report a tachyon pulse," announced Rhombus.

Keith let out his breath; he hadn't been aware that he'd been holding it until then. The pulse meant something was coming through the shortcut; the probe was returning. They watched as the shortcut grew from an infinitesimal point to a meter in diameter, with a violet periphery. The cylindrical object popped through. Keith nodded slightly: the probe appeared undamaged. It maneuvered back towards *Starplex* under its own power, meaning its internal electronics were still intact, and slid down the launching tube into its berth. Umbilicals were attached to it, and its store of data was uploaded into PHANTOM, *Starplex*'s central computer.

"Let's see it," Keith said, and Rhombus complied, replacing the spherical hologram of space outside *Starplex* with what the probe had seen on the other side of the shortcut. At first, it

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just seemed to be more space, different constellations enveloping them. There were murmurs of disappointment. One always hoped that a spacecraft would be visible—a ship from whatever race had brought the shortcut on-line.

Jag got out of his chair, and walked around to stand in front of the two rows of workstations. He rotated on his hooves, looking at various parts of the hologram, then began interpreting what was visible for the rest of them. "Well," said a translated Brooklyn accent overtop of his dog-barks, "it looks like normal interstellar space. Just what you'd expect for the Perseus Arm—lots of blue stars, not too densely packed." He stopped and pointed. "See that band of light? We're on the inner edge of the Perseus Arm, looking back towards the Orion Arm. Neither Galath nor Hotspot would be visible from here, but we might be able to find Sol in a telescope."

He began a circumnavigation of the bridge, his black hooves ticking against the invisible floor. "The only thing that looks bright enough to be a nearby main-sequence star is that one there." He indicated a blue-white point that was indeed brighter than all the others. "Still, it shows no sign of a visible disk, so at a minimum we are several billion kilometers from it. Of course, we can use a couple of probes to do some long-base-line parallax tests to see how close it is as soon as we go through the shortcut; I don't normally favor A-class stars for having habitable planets, but it seems as good a place as any to start looking for whomever activated this exit."

"So you think it's safe for us to go on through?" Keith asked.

The Waldahud turned to face him, and his left pair of eyes blinked. "There doesn't appear to be any immediate danger," he said. "I'll want to review the rest of the probe's data, but it looks just like, well, space."

"OK. In that case, let's try—"

"Just a second," said Jag, apparently catching sight of a part of the hologram over Keith's shoulder. He walked toward the director, then continued on, past the seating gallery behind his station. "Just a second," he said again. "Rhombus, how much real-time hologram is left?"

"I abase myself to admit we exhausted the real-time playback two minutes ago," said the Ib at the ExOps console. "I've been looping the playback since then."

Jag walked over to the bridge wall—which was something like taking a few steps toward a distant mountain in hopes that doing so would improve one's view of it. He peered into the darkness. "That area there," he said, circling his upper left arm to indicate a large portion of the starfield. "There is something unusual . . . Rhombus, speed up the playback. Ten times normal rate, and loop it continuously."

"Done without rancor," said Rhombus, ropes snapping.

"That can't be," said Thor, who had turned around to look as well. He half-rose from his chair at the helm console.

"But it is," said Jag.

"What is it?" asked Keith.

"You see it," said Jag. "Look."

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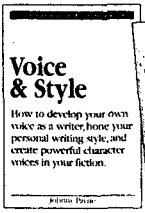
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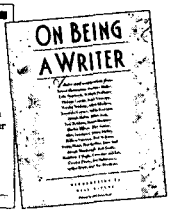

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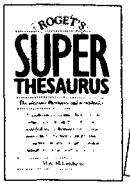

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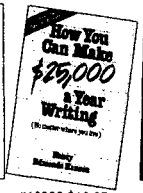

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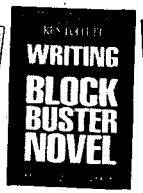

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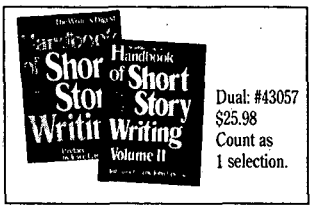

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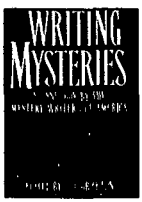

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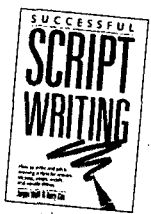

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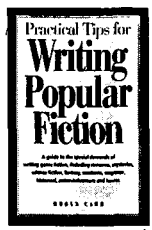

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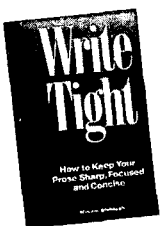

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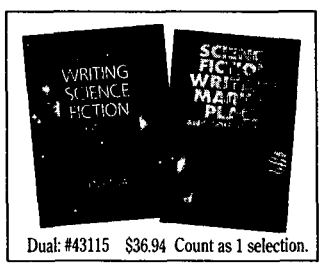

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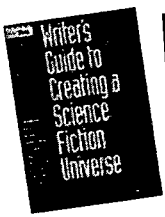

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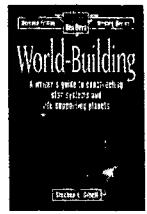

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"All I see is a bunch of stars twinkling."

Jag lifted his upper shoulders, the Waldahud equivalent of a nod of assent. "Exactly. Just like a clear winter's night back on your wondrous Earth, no doubt. Except," he said, "that stars do not twinkle when seen from space."

Gamma Draconis

You hold, *the glass man had said,* not only the key to the future, but also to the past. *The glass man's words echoed in Keith's mind. He looked around at trees, the lake, the blue sky. All right, all right—Glass had said it was not a cage, not a zoo, that he could leave at any time. Still, his head was reeling. Maybe it was because all this was too much to take in at once, despite Glass's attempt to provide familiar surroundings. Or maybe the sensation was an after-effect of Glass's mind-probe—Keith still suspected something like that was at work here. Either way, he found himself feeling dizzy, and decided to lower his body down to the grass. At first he kneeled, but then he moved into a more comfortable position, with his legs sticking out to one side. He was astonished to see he'd gotten a grass stain on the knee of his pants.*

The glass man flowed into a lotus position about two meters away from Keith. "You introduced yourself as G. K. Lansing."

Keith nodded.

"What does the 'G' stand for?"

"Gilbert."

"Gilbert," said Glass, nodding his head as if this were significant.

Keith was perplexed. "Actually, I go by my middle name, Keith." A self-deprecating chuckle. "You would, too, if your first name was Gilbert."

"How old are you?" asked Glass.

"Forty-six."

"Forty-six? Just forty-six?" The being's tone was strange—wistful or perplexed.

"Umm, yes. Forty-six Earth-years, that is."

"So young," Glass said.

Keith lifted his eyebrows, thought about his bald spot.

"Tell me about your mate," asked Glass.

Keith's eyes narrowed. "Why would you possibly be interested in that?"

Wind-chime laughter. "I am interested in everything."

"But questions about my mate—surely there are more important things to explore?"

"Are there more important things to you?"

Keith thought for a second. "Well—no. No, I suppose there aren't."

"Then tell me about—about her, *I presume."*

"Yes, her."

"Tell me."

Keith shrugged. "Well, her name is Rissa. That's short for Clarissa. Clarissa Maria Cervantes." Keith smiled. "Her last name always makes me think of Don Quixote."

"Who?"

"Don Quixote. The Man of La Mancha. Hero of a novel by a writer named Cervantes." Keith paused. "You'd like Cervantes—he once

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wrote a book about a glass man. Anyway, Quixote was a knight-errant, caught up in the romance of noble deeds and the pursuit of unattainable goals. But. . . ."

"But what?"

"Well, the funny thing is that it was Rissa who used to call me quixotic."

Glass tipped his head in puzzlement, and Keith realized that he couldn't discern the connection between the unknown and apparently unrelated words kwik-sah-tik *and* kee-hoe-te *" 'Quixotic' means similar to Don Quixote," said Keith. "Visionary, romantic, impractical—an idealist bent on righting wrongs." He laughed. "Of course, I wasn't content to love Rissa pure and chaste from afar, but I suppose I do have a tendency to take on battles other people let pass, or aren't even aware of, and, well. . . ."*

The egg-shaped transparent head tilted slightly. "Yes?"

"Well," said Keith, spreading his arms, encompassing not just the forest simulation but everything beyond, "we did reach the unreachable stars, didn't we?" He grew silent, feeling a little embarrassed. "Anyway, you were asking about Rissa. We have been married—permanently pair-bonded—for almost twenty years now. She's a biologist—an exobiologist, to be precise; her specialty is life that is not indigenous to Earth."

"And you love her?"

"Very much indeed."

"You have children." Keith assumed it was a question, but Glass's voice did not rise at the end of the sentence.

"One. His name is Saul."

"Sol? After your home star?"

"No, Saul. S-A-U-L. After the man who had been my best friend before he died, Saul Ben-Abraham."

"So your son's name was—what? Not Saul Lansing-Cervantes?"

Keith was surprised that Glass grasped human naming conventions. "Yes, that's right."

"Saul Lansing-Cervantes," repeated Glass, his head tilted as if lost in thought. He looked up. "Sorry. It's, ah, quite a musical name."

"Which you'd say is funny, if you knew him," said Keith. "I love my son, but I've never met anyone with less musical talent. He's nineteen now, and is away at university. He's studying physics; that's something he does *have an aptitude for, and I suspect someday he'll make quite a name for himself in that field."*

"Saul Lansing-Cervantes . . . your son," said Glass. "Fascinating. Anyway, we keep getting off the topic of Rissa."

Keith looked at him for a moment, puzzled. But then he shrugged. "She's a wonderful woman. Intelligent. Warm, funny. Beautiful."

"And you say you are pair-bonded with her?"

"That's right."

"And that means . . . monogamy, correct? You couple with no one else?"

"Yes."

"Without exception?"

"Without exception, that's right." A pause. "So far."

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"So far? You are contemplating a change in this relationship?"

Keith looked away. Christ, this is crazy. What could this alien possibly know about human marriage? "Move along," said Keith.

"Pardon?" asked Glass.

"Move along, move along. Another topic."

"Do you feel guilty, Keith?"

"What are you—my bloody conscience?"

"I am just someone who is interested, that's all."

"Become interested in something else."

"I'm sorry," said Glass. "Where did you and Rissa first meet?"

"La Belle Aurore. *The Germans wore gray; she wore blue."*

"Pardon?"

"Sorry. Another knight-errant hero of mine said that. We met at a party on New Beijing—that's the Earth colony on Tau Ceti IV. She was working in the same lab there as someone I had gone to school with."

"Was it—what is the saying? Was it love at first sight?"

"No. Yes. I don't know."

"And you have been married for twenty years?" asked Glass.

"Just about. Our anniversary is next week."

"Twenty years," said Glass. "A blink of an eye."

Keith frowned. "Actually, it's considered quite an achievement to make it work that long."

"Apologies for my comment," said Glass. "Congratulations." A pause. "What do you like most about Rissa?"

Keith shrugged. "I don't know. Several things. I like that she is content with who she is. Me, I've got to put on airs—to sometimes pretend I've accomplished more, or am more sophisticated, than I really am. In fact, it's common among humans who have attained a significant position to suffer from what's called 'the impostor syndrome'—the fear that others are going to discover that they don't deserve what they've got. I admit to having a touch of that, but Rissa is immune to it. She never pretends to be anything she's not."

Glass nodded.

"And I like her equanimity, her evenness of temper. If something goes wrong, I tend to swear and get upset by it. She just smiles and does whatever needs to be done to set things right. Or if they can't be set right, she accepts it." Keith paused. "In many ways, she's a better person than I."

Glass seemed to consider this for a moment. "She sounds like someone you should hold onto, Keith."

Keith looked at the transparent man, perplexed.

CHAPTER 3

A child's blocks. That's the image that had come to Keith Lansing's mind two years ago, while watching *Starplex*'s components being assembled at the Rehbollo orbital shipyards. The giant ship was made up of just nine pieces, eight of which looked identical.

The largest piece was the central disk/shaft combination. The disk was 290 meters in diameter and 30 meters thick. The square shaft extended up

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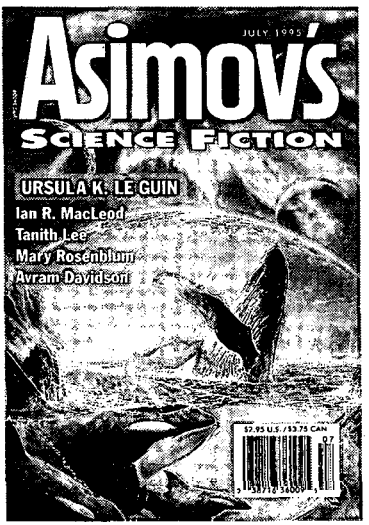

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and down from the center of the disk 90 meters in each direction, making *Starplex* a total of 210 meters tall. A parabolic radio/hyperspace-telescope dish was set into each of the shaft's end caps.

The central disk actually consisted of three wide rings surrounding the shaft. First, stretching out to a radius of 95 meters, was the vast space that would be filled with 686,000 cubic meters of salt water, forming the ocean deck. Second, 20 meters wide and ten decks thick, was the engineering torus. The final ring consisted of *Starplex*'s eight mammoth cargo holds and twenty docking bays, their space doors arrayed along the disk's curving edge.

The other building blocks were the eight habitat modules. Each was a right-triangular prism, 90 meters tall, 90 meters wide at its base, and 30 meters thick. One module was attached to each of the four sides of the shaft that stuck out above the disk. These were mirrored by four more mated to the portion that protruded below. In profile the assembled ship resembled a diamond with a bar through it; seen from above, it was a circle with the interlocking habitats forming a cross in its center.

Each habitat module was divided into thirty decks. Any of the modules could be replaced to accommodate a new race or special equipment, or one could be left behind as a separate base for long-term explorations in a new sector.

In the year since the ship had been launched, *Starplex*'s missions had been uneventful. But now, at last, a real first-contact situation was at hand. Now, at last, all that the great ship had to offer would be put to the test.

A second, more sophisticated probe was sent through to the newly opened sector. It, too, detected the twinkling stars, and its hyperspace telescopes indicated a solar-system's worth of mass was present in the vicinity; to get more resolution of exactly how the mass was deployed would require much larger 'scopes, such as those that were set into either end of *Starplex*'s central shaft.

Keith next ordered a probeship with a human and an Ib from Jag's staff to fly through to the other side and do a more complete reconnaissance. They didn't actually travel into the source of the twinkling stars. There was no way to communicate in real-time through a shortcut, so if they got in trouble it might be too late to help before *Starplex* realized it. But they did do full-spectrum EM scans, a complete-sky search for artificial radio signals, and so on. They returned to *Starplex,* reporting that there was no apparent danger on the other side, although the cause of the twinkling starscape remained as elusive as ever.

Keith waited until all data from the two probes and the crewed reconnaissance had been reviewed by each department. Finally, satisfied that it would represent a low risk, he ordered Thor to take *Starplex* itself through the shortcut into the newly opened sector of space.

People occasionally used the terms "wormhole" or "tunnel" as synonyms

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for shortcut, but that wasn't correct. There was no intervening space between the shortcut entrance and the exit. They were like doors between rooms in a house with paper-thin walls: as you walked through, you were partly in one room and partly in another. As simple as that—except that the rooms were separated by many light-years.

The Commonwealth had slowly worked out how to navigate the shortcut network. In normal space, a dormant shortcut is a point. But in hyperspace, that point is surrounded by a rotating sphere of tachyons. The tachyons move along millions of polar orbital lines, all of which are equally spaced, except that one is missing on one side, its tachyon looping back in a hemispherical path. That narrow tachyon-free gap is known as "the zero meridian," and it means you can treat the sphere of tachyons just like a planetary globe, with a coordinate system of longitude and latitude.

To travel through a shortcut, you set a straight-line path toward the point at the center of the sphere. As you approach that point, you pass through the sphere at a specific latitude and longitude. Those coordinates determine which other shortcut you will exit from: where in the Galaxy you come out depends on the direction from which you approached the local shortcut.

Of course, to get the ball rolling, there had to be one shortcut on-line at the outset that was not associated with any race—otherwise there'd be no location for the first emerging civilization to travel to with their shortcut. The initial shortcut—Shortcut Prime—was clearly a freebie, given by the shortcut makers. It was located in the heart of the Milky Way Galaxy, within sight of the central black hole. Earth's initial explorations of that sector had found no native life there, of course; the galactic core was far too radioactive for that.

At the beginning of the Commonwealth, there were only four active shortcuts—Tau Ceti, Rehbollo, Flatland, and Shortcut Prime. As more shortcuts were activated, the acceptable approach angles for each possible exit became smaller. After a dozen shortcuts were on-line, it became clear that to return to the Tau Ceti shortcut, one had to pierce the tachyon sphere surrounding another shortcut at about 115 degrees east longitude and 40 degrees north latitude. On Earth, that's close to Beijing, which gave rise to the "New Beijing" nickname for the colony on Silvanus, Tau Ceti's fourth planet.

When a ship touches the shortcut, the shortcut point expands—but only in two dimensions. It forms a hole in space perpendicular to the direction of the ship's travel. The hole's shape is the same as the cross-sectional profile of whatever part of the ship is passing through it. The opening is outlined in a violet ring of Soderstrom radiation, caused by tachyons spilling out around the edges and spontaneously translating into slower-than-light particles.

An observer looking at the shortcut from the front would see the ship disappearing into the violet-limned entrance. Looking from the back, he or

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she would only see a black void blocking the background stars; the void would have the same silhouette as the disappearing object.

Once the ship was all the way through, the shortcut loses its height and width, collapsing back down to nothingness—awaiting the next galactic traveler. . . .

Thor sounded the pre-transfer alarm, five successively louder electronic drumbeats. Keith touched keys, and his number-two monitor switched to a split-screen mode. One side displayed normal space, in which the shortcut was invisible; the other, a computer simulation based on hyperspace scans, showing the shortcut as a bright white point on a green background surrounded by a glowing orange sphere of field lines.

"All right," said Keith. "Let's do it."

Thor operated controls. "As you say, boss."

Starplex closed the twenty kilometers between itself and the shortcut, and then it touched the point. The shortcut expanded to accommodate the ship's diamond-shaped profile, fiery purple lips matching the giant mothership's shape. As *Starplex* passed through, the holographic bubble surrounding the bridge showed the two mismatched starfields, and the stormy discontinuity between them that moved from bow to stern as they completed their passage. As soon as the ship was all the way through, the shortcut shrank back down to nothingness.

And there they were, in the Perseus Arm—two-thirds of the way across the Galaxy, and tens of thousands of light-years from any of the homeworlds.

"Shortcut passage was normal," said Thor. The tiny hologram of his face floating above the rim of Keith's workstation was lined up with the back of Thor's actual head, and the holographic mass of red hair blended into the real mane beyond, making his ax-blade features seem lost in a vast orange sea.

"Good work," said Keith. "Let's drop a marker buoy."

Thor nodded and pushed some keys. Although the shortcut stood out in hyperspace, if *Starplex*'s hyper-radio equipment broke down, they'd have trouble finding it again. The buoy, broadcasting on normal EM frequencies and containing its own hyperscope, would be their beacon home in that case.

Jag got up and pointed out the twinkling stars again; they were quite easy to see. Thor rotated the holographic bubble so that they appeared front and center, instead of off behind the observation gallery.

Lianne Karendaughter was leaning forward at her workstation, a delicate hand supporting her chin. "So what's causing the twinkling?" she said.

Behind her, Jag lifted all four shoulders in a Waldahud shrug. "It can't be atmospheric disturbances, of course," he said. "Spectrographs confirm that we're in a space-normal vacuum. But something is in between our ship and the background stars—something that is at least partially opaque and shifting."

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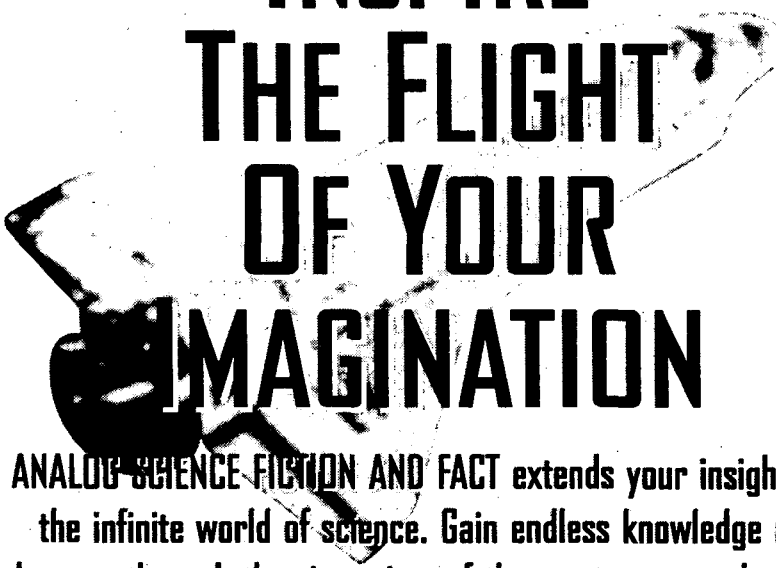

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"Perhaps a non-luminous nebula," said Thor.

"Or, if I may be allowed a suggestion, perhaps just a tract of dust," said Rhombus.

"I'd like to know how far away it is before I hazard a guess," said Jag.

Keith nodded. "Thor, shoot a comm laser at—at whatever it is."

Thor's broad shoulders moved as he worked controls on either side of his workstation. "Firing."

Three digital counters appeared floating in the holographic display. Each one incremented at a different rate, in the smallest standard units of each of the three homeworld's timekeeping systems. Keith watched the one counting seconds climb higher and higher.

"Reflected light received at seventy-two seconds," said Thor. "Whatever is out there is pretty damn close—about eleven million klicks away."

Jag was consulting his monitors. "Hyperspace telescope readings show that the obstructing material consists of a large amount of mass—a sixteen-multiple or more times the combined mass of all the planets in a typical solar system."

"So it's not spaceships," said Rissa, disappointed.

Jag lifted his lower shoulders. "Probably not. There's a small chance that we're seeing a large number of vessels—a vast fleet of craft, whose individual movements are eclipsing background stars, and whose artificial gravity generators are making big dents in space-time. But I doubt that."

"Let's close the distance by half, Thor," said Keith. "Bring us in to about six million klicks from the periphery of the phenomenon. See if we can make out more detail."

The little face and the big head behind it nodded in unison. "As you say, boss."

As he brought the ship closer, Thor also rotated *Starplex* so that deck one was facing forward into its direction of movement. The ship's thrusters could move the vessel in any direction, regardless of its orientation, but one of the twin radio telescopes was mounted in the center of that square deck, and four optical telescopes were mounted at the corners.

As they got closer, it became apparent that whatever was obscuring the background stars was reasonably solid and large. Stars were being eclipsed now with only a short period of fading out as they disappeared. But there wasn't enough light to see clearly. The nearby A-class star was just too far away. So far, all that they could make out was a series of maddeningly vague shadows.

"Any radio signals?" asked Keith. As had become his habit, he'd shut off the hologram of Lianne's head that by default hovered above the rim of his console. In the past, he'd found himself staring at it, and that was awkward with Rissa sitting right next to him.

"Nothing major," she said. "Just wisps of milliwatt noise now and again near the twenty-one-centimeter line, but it's all but lost against the cosmic microwave background."

Keith looked to Jag, seated on his left. "Ideas?"

The Waldahud was growing frustrated as they got closer—his fur was

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standing up in tufts. "Well, an asteroid belt seems unlikely, especially this far from the nearest star. I suppose it could be material in the A's Oort, but it seems much too dense for that."

Starplex continued to move in. "Spectroscopy?" asked Keith.

"Whatever those objects are," barked Jag, "they're non-luminous. As for absorption of starlight from behind as it passes through the less opaque parts, the spectra I'm seeing is typical of interstellar dust, but there's much less absorption going on than I'd expect." He turned to face Keith. "There's simply not enough light out here to see what's going on. We should send up a fusion flare."

"What if they *are* ships?" asked Keith. "Their crews might misconstrue it—think we're launching an attack."

"They are almost certainly not ships," said Jag curtly. "They are planet-sized bodies."

Keith looked at Rissa, at the holographic Thor and Rhombus, and at the back of Lianne's head, to see if any of them had any objections. "All right," he said. "Let's do it."

Jag got up and walked over to stand beside Rhombus at the external-operations station. Keith found it funny watching them talk: Jag barking like an angry dog, and Rhombus replying in shimmering lights. Since they were just conversing amongst themselves, PHANTOM didn't bother to translate their words for Keith, but Keith tried to listen in, just for the practice. Waldahudar was a difficult language for English-speakers to follow, and it required a different grammatical mood depending on the gender of the speaker and the person being spoken to (males could only address females in a conditional/subjunctive way, for instance). On the other hand, specific nouns were avoided as much as possible in polite Waldahudar, lest disagreements over terminology ensue. Throughout the conversation, Jag leaned on Rhombus's workstation for support; his medial limbs could be used for locomotion or manipulation, but Waldahudin didn't like dropping down onto their rear four in the company of humans.

Finally, Jag and Rhombus had agreed on what characteristics the flare should have. Lianne at InOps issued an order that all windows on decks one through thirty be covered or turned opaque. She also drew the protective covers over sensitive external cameras and sensors.

When that was done, Rhombus launched the flare—a ball about two meters in diameter—out through a horizontal mass-driver tube that exited on the outer rim of the central disk. He let the flare get about twenty thousand klicks above the ship and then ignited it. The flare burned with the light of a miniature sun for eight seconds.

Of course, it took the light from that flare almost twenty seconds to reach the beginning of the phenomenon that was obscuring the background stars. It turned out that the phenomenon was roughly spherical, measuring some seven million kilometers in diameter, so it took twenty-four seconds—or three times the length of the light pulse—for the illumination to pass through it in a circu-

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lar band. When it was done, Rhombus summed the various illuminated parts of the image to give a view of the whole thing as if it had been lit up simultaneously. In the all-encompassing hologram, the bridge crew could finally see what was out there.

There were dozens of gray-and-black spheres, each one so dark that the illuminated side was hardly much brighter than the unilluminated one.

"Each of the spheres is roughly the size of the planet Jupiter," said Thor, his head bent down, consulting a read-out. "The smallest is 110,000 klicks wide; the largest, about 170,000. They're clustered into a spherical volume seven million klicks wide, or about five times the diameter of Sol."

The individual orbs looked a lot like black-and-white photographs of Jupiter, except that they didn't have neat latitudinal bands of cloud. Rather, the clouds—or whatever it was that formed the visible surface markings—seemed to swirl in simple convection cells from equator to pole, the kind of pattern one might expect if the spheres had next to no rotation. In the intervening space between the world-sized spheres was a diaphanous fog of gas or particles that formed a translucent haze; doubtless this fog had been responsible for most of the twinkling effect they'd observed. The whole thing—spheres and surrounding fog—looked like assorted steel ball bearings rolling around in a pile of black silk stockings.

"How do they—" barked Jag, and Keith immediately knew what he was going to say. How could world-sized objects be packed so closely together? There were perhaps ten diameters between the closest of the objects, and fifteen or so between the ones that were least tightly packed. Keith couldn't imagine any pattern of stable orbits that would keep them from collapsing together under their own gravitational attraction. If this was a natural grouping, it seemed unlikely that it could be an old one. Throwing some light on the subject had only made the mystery deeper.

CHAPTER 4

On Earth, cells contain mitochondria for converting food to energy, undulopodia (thrashing tails including those that propel sperm), and, in plants, plastids for storing chlorophyll. The ancestors of these organelles were originally independent free-swimming creatures. They came together in symbiosis with a host being whose DNA is now walled off in the nucleus; to this day, some organelles still contain vestigial DNA of their own.

On Flatland, diverse ancestors also learned to work together, but on a much grander scale. An Ib was actually a combination of seven large life forms—indeed, "Ib" is short for "integrated bioentity."

The seven parts are the *pod*, the watermelon-shaped creature containing the supersaturated solution in which the crystals of the principal brain grow; the *pump*, the digestive/respiratory structure that surrounds the pod like a blue sweatshirt tied around a green pot belly, with tubular arms hanging down for feeding and excret-

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ing; the twin *wheels,* fleshy hoops coated with quartz; the *frame,* a saddle-shaped gray construct that provides axles for the wheels and anchor points for the other elements; the *bundle,* sixteen copper-colored ropes that normally form a heap in front of the pump but can snake out as needed; and the *web,* a sensor net that covers the pump, pod, and upper frame.

The web has an eye and a bioluminescent dot wherever two or more of its strands intersect. Although they have no speech organs, Ibs hear as well as terrestrial dogs do, and they accept with good humor spoken names bestowed by members of other races. *Starplex*'s ExOps Manager was Rhombus; Snowflake was senior geologist; Vendi (short for Venn Diagram) was a hyperdrive engineer; and Boxcar—well, Boxcar was the biochemist with whom Rissa was collaborating on the most important project in history.

In 1972, Earth's Club of Rome began preaching the limits of growth. But with all of space now at humanity's fingertips, there were no more constraints. To hell with the textbook 2.3 children. If you wanted $2x10^3$ kids, there was room enough for all of them—and for you, too. The argument that individuals *had* to die in order to allow the race to advance no longer applied.

Boxcar and Rissa were trying to increase the life spans of the Commonwealth races. The problem was daunting; so much of how life worked still remained mysterious. Rissa doubted that the riddle of aging would be solved in her lifetime, although within a century someone would likely find the key. The irony was not lost on her: Clarissa Cervantes, senescence researcher, probably belonged to the final human generation that would know death.

The average human life span was a hundred Earth years; Waldahudin lived to be about forty-five (the fact that they were self-sufficient after only six years didn't quite compensate for the shortness of their span; some humans thought the knowledge that they were the shortest-lived of the Commonwealth sentients was what made them so disagreeable); dolphins were good for eighty years with proper health care; and, barring accidents, an Ib would live for precisely 641 Earth years.

Rissa and Boxcar thought they knew why Ibs lived so much longer than the other races. Human, dolphin, and Waldahud cells all have a Hayflick limit: they properly reproduce only a finite number of times. Ironically, Waldahud cells had the highest limit—about ninety-three times—but their cells, like the creatures composed of them, had the shortest life cycle. Human and dolphin cells could divide about fifty times. But the organelle clusters—there was no overall membrane to make them a single cell—that made up the body of an Ib could reproduce indefinitely. What eventually kills most Ibs is a mental short-circuit: when the crystals of the central brain, which form matrices at a constant rate, reach their maximum information capacity, the overflow causes the basic routines governing respiration and digestion to become garbled.

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Since she didn't seem to be needed on the bridge, Rissa had gone down to her lab to join Boxcar. She was sitting in a chair; Boxcar was positioned next to her. They watched the data scrolling up the monitor plate rising from the desk in front of them. The Hayflick limit had to be governed by cellular timers of some sort. Since it was observed in cells from both Earth and Rehbollo, they'd hoped comparison genome mapping would help. Attempts to correlate across genetic platforms the mechanisms for timing body growth, puberty, and sexual functions had all been successful. But, maddeningly, the cause of the Hayflick limit remained elusive.

Maybe this latest test—maybe this statistical analysis of inverted telomerase RNA codons—maybe—

Lights winked on Boxcar's sensor web. "It saddens me to note that the answer is not there," said the translated voice, British, as all Ib voices were, and female, as half of them were arbitrarily assigned.

Rissa let out a heavy sigh. Boxcar was right; another dead end.

"I intend no offense with this comment," said Boxcar, "but I'm sure you know that my race has never believed in gods. And yet when I encounter a problem like this—a problem that seems, well, *designed* to thwart solution—it does make one think that the information is being deliberately withheld from us, that our creator does not want us to live forever."

Rissa made a small laugh. "You may be right. A common theme among human religions is the belief that gods jealously guard their powers. And yet why build an infinite Universe, but put life on only a handful of worlds?"

"Begging your generous pardon for pointing out the obvious," said Boxcar, "but the Universe is only infinite in that it has no borders. It does however contain a finite amount of matter. Still, what is it that your god is said to have commanded? Be fruitful and multiply?"

Rissa laughed. "Filling the Universe would take an awful lot of multiplying."

"I thought that was an activity you humans enjoyed."

She grunted, thinking of her husband. "Some more than others."

"Forgive me if I'm being intrusive," said Boxcar, "but PHANTOM prefaced the translation of your last sentence with a glyph indicating that you spoke it ironically. It is doubtless me who is to blame, but I seem to be missing a layer of your meaning."

Rissa looked at the Ib—a faceless, six-hundred-kilogram wheelchair. Pointless to discuss such matters with her—with *it*, a sexless gestalt that knew nothing of love or marriage, a creature to whom an entire human life span was a brief interlude. How could it understand the stages a marriage went through—the stages a *man* went through?

And yet—

She could not talk about it with her female friends aboard ship. Her husband was *Starplex*'s director, the . . . the *captain* they would have called it in the old days. She couldn't chance gossip getting around, couldn't risk diminishing him in the eyes of the staff.

Rissa's friend Sabrina had a husband named Gary. Gary was going

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through the same thing—but Gary was just a meteorologist. Not someone to whom everyone looked up, not someone who had to endure the gaze of a thousand people.

I'm a biologist, thought Rissa, and Keith's a sociologist. How did I ever end up a politician's wife, with him, me, and our marriage under the microscope?

She opened her mouth, about to tell Boxcar that it was nothing, nothing at all, that PHANTOM had mistaken fatigue or perhaps disappointment in the latest experiment's results for irony.

But then she thought, why the hell not? Why not discuss it with the Ib? Gossiping was a failing of *individual* life forms, not of gestalt beings. And it would feel good—oh so very good—to get it off her chest, to be able to share it with someone.

"Well," she said—an articulated pause, giving herself one last chance to rein in her words. But then she pressed on: "Keith is getting old."

A slight ripple of lights on Boxcar's web.

"Oh, I know," said Rissa, lifting a hand. "He's young by Ibese standards, but, well, he is becoming middleaged for a human. When that happens to a human female, we undergo chemical changes associated with the end of our child-bearing years. Menopause, it's called."

Lights playing up the web; an Ibese nod.

"But for male humans, it isn't so cut-and-dried. As they feel their youth slipping away, they begin to question themselves, their accomplishments, their status in life, their career choices, and . . . well, whether they are still attractive to the opposite sex."

"And is Keith still attractive to you?"

Rissa was surprised by the question. "Well, I didn't marry him for his looks." That hadn't come out the way she'd intended. "Yes, yes, he's still attractive to me."

"It is doubtless wrong for me to remark upon this, and for that I apologize, but he is losing his hair."

Rissa laughed. "I'm surprised you would notice something like that."

"Without intending offense, please know that telling one human from another is difficult for us, especially when they are standing close by and so are visible to only part of our webs. We're attentive to individual details. We know how upsetting it is to humans to not be recognized by someone they think *should* know them. I have noticed both his loss of hair and its change of color. I have learned that such changes can signal a reduction in attractiveness."

"I suppose they can, for some women," said Rissa. But then she thought, this is silly. Dissembling to an alien. "Yes, I liked his looks better when he had a full head of hair. But it's such a minor point, really."

"But if Keith is still attractive to you, then—forgive my boundless ignorance—I don't see what the problem is."

"The problem is that he doesn't care if he's still attractive to *me*. Appealing to one's mate is taken as a given. I suppose that's why men in the past often put on weight after they'd gotten married. No, the question run-

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ning through Keith's mind these days, I'm sure, is whether he's attractive to *other* women."

"And is he?"

Rissa was about to respond with a reflex "of course," but then paused to really consider the question—something she hadn't done before. "Yes, I suppose he is. Power, they say, is the ultimate aphrodisiac, and Keith is the most powerful man in—in our space-going community."

"Then, begging forgiveness, what is the difficulty? It sounds as though he should have the answer to his question."

"The difficulty is that he may have to prove it to himself—prove that he's still attractive."

"He could conduct a poll. I know how much you humans rely on such information."

Rissa laughed. "Keith is more of . . . more of an *empiricist,*" she said. Her tone sobered. "He may wish to conduct experiments."

Two lights winking. "Oh?"

Rissa looked at a point high up on the wall. "Whenever we're in a social situation with other humans, he spends too much time with the other women present."

"How much is too much?"

Rissa frowned, then said, "More than he spends with me. And often, he's off talking to women who are half his age—half *my* age."

"And this bothers you."

"I guess so."

Boxcar considered for a moment, then: "But is this not all natural? Something all men go through?"

"I suppose."

"One cannot fight nature, Rissa."

She gestured at the monitor, with the negative results of the last Hayflick-limit study still displayed on it. "So I'm beginning to find out."

CHAPTER 5

"Get me a sample of the material those spheres are made of," barked Jag, standing up at his bridge station and looking at the director. Keith gritted his teeth, and thought, as he often did, of asking PHANTOM to translate Jag's words less directly, inserting the human niceties of "please" and "thank you."

"Should we send a probe?" Keith asked, looking at the Waldahud's four-eyed face. "Or do you want to go out yourself?" If the latter, thought Keith, I'd be glad to show you the airlock door.

"A standard atmospheric-sampling probe," said Jag. "The gravitational interplay between that many large bodies so close together must be complex. Whatever we send out might end up crashing into one of them."

All the more reason to send Jag, thought Keith. But what he said was, "A probe it is." He turned and looked at the workstation positioned at two o'clock to his own. "Rhombus, please take care of that."

The Ib's web rippled assent.

"A delta-class probe would be most appropriate," said Jag, slipping back into his chair and speaking now into a little hologram of Rhombus above the rim of his console.

Keith tapped a key and joined the conference as well; a miniature Waldahud head popped up in front of

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him next to the full body shot of the Ib. "How many spheres are there in total?" asked Keith.

Rhombus's ropes operated controls. "Two hundred and seventeen," he said. "But they all look pretty much the same, except for some variation in size."

"Well, then, for an initial test, it doesn't make any difference which sphere we sample," said Jag. "Choose the one that presents the fewest navigational difficulties. First, scoop up some of that material that's between the spheres. Then buzz into one of the spheres and get me a sample of the gas, or whatever it is that they're made of. Take some from the top of the clouds, and another sample from about two hundred meters down into the clouds, if the probe can stand the pressure. As you fill them, heat and pressurize the sample compartments to match the ambient at the collection points; I want to minimize chemical changes in the material."

Lights moved up Rhombus's sensor web, and a few moments later he was launching the probe. He switched the control-room spherical display to the view from the probe's cameras. The stars that were behind the haze between the spheres still seemed to be twinkling; the spheres themselves were just circles of black against a backdrop that consisted of a starfield and some faint blue nebulosity beyond.

"What do you think the spheres are?" asked Rhombus, while the probe closed toward its target.

Jag moved all four of his shoulders in a Waldahud shrug. "Might be the remnants of a brown dwarf star that recently blew apart. Any fluid will take on a spherical shape in zero-*g*, of course. The material in between will presumably eventually be swept up by the larger bodies."

The probe was getting close to the material between the spheres. "The fog seems to consist of gas studded with solid particles averaging about seven millimeters in diameter," said Rhombus, whose sensor web had partially crawled onto the console in front of him so that he could read the instruments more easily.

"What kind of gas?" Keith asked.

"Its apparent molecular weight suggests a reasonably heavy or complex compound," replied Jag, now looking at one of his monitors. "However, the absorption spectrum is that of normal space dust—carbon grains, and so on." A pause. "There's no discernible magnetic field around the spheres. That's surprising; I had supposed the gas particles might have been held in place by such fields."

"Will the probe be damaged by impact with the particles?" asked Keith.

"It pleases me to respond in the negative," said Rhombus. "I'm slowing the probe down to avoid that."

Part of the hologram was obscured as the hatch that covered the atmospheric scoop opened up—bad design, that. "Now collecting samples of the material between the spheres," said Rhombus. A few moments later the view cleared as the hatch closed. "Sample bay one full," the Ib reported. "Changing course for atmospheric skim."

The starfield wheeled around as the probe altered its trajectory. One of the

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circles of blackness was soon in the center of its view. The ebony sphere grew larger and larger until it dominated everything. The probe had headlights, which Rhombus had turned on. They made two murky shafts that penetrated a few meters into the dark, swirling material. A different part of the view was obscured as another sample hatch opened.

"Taking upper-atmosphere samples," reported the Ib, and then, a moment later, "Sample container full."

"Adequate," said Jag. "Now dive down two hundred meters—or however far you can go safely—and get some more sphere material."

"Doing so, in harmonious peace," said Rhombus's clipped tones.

Everything was pitch black, except for the twin pools of light from the headlight beams. They were now only penetrating a meter or so. For one brief moment, something solid seemed to be in the probe's path—an ovoid shape the size of a dirigible—but it was gone from view almost at once.

"Depth now ninety-one meters," said Rhombus. "Surprising. External pressure is very light—far less than I'd have expected."

"Keep going down, then," said Jag.

The probe continued to descend. Rhombus's web flashed in consternation. "The pressure sensor must have been damaged—maybe an impact with a piece of gravel. I'm still reading almost no atmospheric pressure."

Jag lifted his upper shoulders. "All right. Fill a compartment here, then bring it all home."

The third hatch did not obscure the camera at all, although its opening probably shook the craft enough that had they been able to see anything the view would have jiggled a bit.

"The internal-pressure gauge inside the sample compartment shows the same almost-zero pressure the external gauge is indicating," said Rhombus. "Of course, they run through the same microprocessor. Anyway, the compartment should have filled instantly, given that it was a vacuum before the hatch opened."

Rhombus left the hatch open for a few more seconds, just to be sure, then closed it, and turned the probe around, bringing it back to *Starplex*.

Once the probe was back in its launching tube, its sample compartments were disengaged and moved by robot arms onto conveyors which took them down to Jag's lab. Jag, meanwhile, took an elevator there himself.

The containers plugged into jacks on the walls of the lab. They didn't have to be opened; sensors and cameras could look inside through the jacks.

Jag sat down in his chair—a real hand-crafted Waldahud seat, not a polychair—and activated the tall, thin monitors in front of him. He then keyed in a sequence of commands that selected a standard barrage of tests, and watched with growing amazement as the results appeared on his screens.

Spectroscopy: negative findings.

Electromagnetic sweep: negative findings.

Beta decay: none.

Gamma-ray emissions: none.

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Screen after screen lit up: negative findings; none; negative findings; none.

He tapped a key, and the scale beneath the testing bay read off the mass of the sample container: 12.782 kilograms.

"Central Computer," called Jag into the air. "Check the spec sheet for this sample container. How much does it mass when empty?"

"The container's mass is 12.782 kilograms," barked PHANTOM in Waldahudar.

Jag swore. "The *fardint* thing is empty."

"Correct," said PHANTOM.

Jag tapped a key, and a hologram of Rhombus appeared. "Teklarg," said Jag, calling the Ib by his name in Waldahudar, "that probe you sent out was defective. All of the sample material from its number-two container leaked out on the way back."

"Sincere apologies, good Jag," said Rhombus. "I submit to punishment for wasting your time, and will dispatch a replacement at once."

"Do so," said Jag, and he stabbed the button that cut off communications. He turned his attention to the number-one sample container . . . and was shocked to discover that it, too, had leaked out its contents on the way back. "Shoddy human engineering," he grumbled to himself.

But he was grumbling even more once the second probe's sample containers had been conveyed to his lab. The readings were the same—including the anomalously low air-pressure readings after it had dived into the large sphere.

Once again, Jag summoned up a hologram of Rhombus.

"I say with all peaceful good wishes, dear Jag, that there does not appear to be anything wrong with either probe. The container seals are perfect. Nothing should have been able to leak out."

"Regardless, whatever samples we are collecting *are* getting out," said Jag. "Which means . . . well, which means that whatever the samples are made of must be unusual stuff indeed."

Lights moved up Rhombus's web. "A fair assumption."

Jag slid his dental plates together. "There must be a way to bring some of that material aboard for study."

"Doubtless you have already thought of this," said Rhombus, "and I waste both our time by mentioning the idea, but we could use a force box. You know, like the kind they use in labs for handling antimatter."

Jag lifted his upper shoulders. "Acceptable. But don't use an EM forcefield; instead, use artificial-gravity fields to hold the contents away from the box's walls, regardless of what acceleration we use."

"Will do, with obeisance," said Rhombus.

The force box was manipulated by tractor beams. It consisted of eight antigrav generators arranged as the corners of a perfect cube, with wide, paddle-like handles sticking off each face's midpoint to give the tractors something to hold on to. The box was pushed into one of the large gray spheres, and opened there. A second box was manipulated into the swarm

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of gravel between two of the spheres and activated there. The two boxes were then quickly hauled back in to *Starplex*.

Finally, the sample containers were maneuvered into separate isolation chambers in Jag's lab. The antigrav trick had been a success: one box did indeed contain samples of the gas that constituted the sphere, and the other held several pieces of translucent gravel plus one partially transparent rock the size of a hen's egg. Now, at last, Jag would find out what they were dealing with.

CHAPTER 6

Keith ran a hand over his pate, and leaned back in his chair, looking out at the starscape hologram enveloping the bridge. There wasn't much else to do, until Jag reported back. Rissa was still off working with Boxcar, and alpha shift was coming to an end. Keith exhaled—probably too noisily. Rhombus had rolled up to the director's workstation to discuss something or other. Lights flashed across the Ib's mantle. "Irritated?" said his translated voice.

Keith nodded.

"Jag?" asked the Ib.

Keith nodded again.

"In politeness, I observe that he's not that bad," said Rhombus. "As Waldahudin go, he's positively genteel."

Keith gestured toward the part of the starfield that hid the door Jag had gone through. "He's so . . . competitive. Combative."

"They're all like that," said Rhombus. "All the males, anyway. Have you spent much time on Rehbollo?"

"No. Although I was in on the first contact between humans and Waldahudin, I always thought that it was best for me to stay away from Rehbollo. I—I've still got a lot of anger over the death of Saul Ben-Abraham, I guess."

Rhombus was quiet for a few moments, perhaps digesting this. Then his web rippled with light again. "Our shift is over, friend Keith. Will you grant me nine minutes of your time?"

Keith shrugged and got to his feet. He addressed the room. "Good work, everyone. Thank you."

Lianne turned around, her platinum hair bouncing as she did so, and smiled at Keith. Rhombus and Keith headed out into the chilly corridor, the Ib rolling beside the human.

A couple of slim robots were moving down the corridor as well. One was carrying a lunch tray for someone; another was running a vacuum cleaner along the floor. Keith still privately thought of such robots as PHARTs—PHANTOM ambulatory remote toilers—but the Waldahudin had started throwing things when it was suggested that *Starplex* terminology contain acronyms nested within acronyms.

Through a window in the corridor wall, Keith could see one of the vertical dolphin-access tubes, consisting of meter-thick disks of water separated by ten centimeters of air held in place by forcefields. The air gaps prevented the water pressure from increasing over the tube's height. As he watched, a bottle-nosed dolphin passed by, swimming up.

Keith looked at Rhombus. Lights

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were flashing in unison on his web. "What's so funny?" Keith asked.

"Nothing," said the Ib.

"No, come on. What is it?"

"I was just thinking of a joke Thor told today. How many Waldahudin does it take to change a light bulb? Answer: five—and each one has to get credit."

Keith frowned. "Lianne told you that same joke weeks ago."

"I know," said Rhombus. "I laughed then, too."

Keith shook his head. "I'll never understand how you Ibs can find the same thing funny over and over again."

"I'd shrug if I could," said Rhombus. "The same painting is pretty each time you look at it. The same dish is tasty each time you eat it. Why shouldn't the same joke be funny each time you hear it?"

"I don't know," said Keith. "I'm just glad I got you to stop telling me that stupid 'that's not my axle—it's my feeding tube' joke every time we met. That was irritating as hell."

"Sorry."

They continued down the corridor in silence for a while, then: "You know, good Keith, it's a lot easier to understand the Waldahudin if you've spent time on their world."

"Oh?"

"You and Clarissa have always been happy together, if you'll permit me to say so. We Ibs don't have such intimacy with other individuals; we shuffle our own genetic material amongst our component parts, rather than bonding with a mate. Oh, I take comfort from my other components—my wheels, for instance, are not sentient, but they have intelligence comparable to that of a terrestrial dog. I have a relationship with them that gives me great joy. But I perceive that the relationship you enjoy with Clarissa is something much, much more. I only dimly understand it, but I'm sure Jag appreciates it. Waldahudin, like humans, have two sexes, after all."

Keith couldn't see where this was going, and, on the whole, thought Rhombus was presuming on their friendship. "Yes?"

"Waldahudin have two sexes, but they do not have equal numbers of each sex," said the Ib. "There are, in fact, five males for every female. Yet, despite this, they are a monogamous race, forming lifetime pairbonds."

"So I've heard."

"But have you contemplated the ramifications of that?" asked the Ib. "It means that four out of every five males end up without a mate—end up being excluded from the gene pool. Perhaps you had to fend off some other suitors in your pursuit of Clarissa—or maybe she had to fend off others who were pursuing you; forgive me, but I've no idea how these things work. But I imagine in such contests it was a comfort to all the participants to know that for each male there was a female, and vice versa. Oh, the pairings might not end up as one might wish, but the chances were good that each man would find a woman, and vice versa—or a mate of their own gender, if that was their preference."

Keith moved his shoulders. "I suppose."

"But for Jag's people, that is not the

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case. Females have absolute power in their society. Every single one of them is . . . courted, I believe is the word . . . by five males, and the female, when she reaches estrus at thirty years of age, will pick her one mate from the five who have spent the last twenty-five years vying for her attentions. You know Jag's full name?"

Keith thought for a moment. "Jag Kandaro em-Pelsh, isn't it?"

"That's right. Do you know its derivation?"

He shook his head.

"Kandaro is a regional designation," said Rhombus. "It refers to the province Jag traces lineage to. And Pelsh is the name of the female of whose entourage he is a member. She's quite a significant power on Rehbollo, actually. Not only is she a famous mathematician, she's also a niece of Queen Trath. I met Pelsh once, while attending a conference. She's charming, intelligent—and about twice Jag's size, as are all adult Waldahud females."

Keith contemplated a mental picture, but said nothing.

"Do you see?" asked Rhombus. "Jag has to make his mark. He has to distinguish himself from the other four males in her entourage if he is to be chosen. Everything a pre-mating Waldahud male does is geared toward making him stand out. Jag came aboard *Starplex* looking for glory enough to earn him Pelsh's affection . . . and he's going to find that glory, no matter how hard he has to push."

That night, lying in bed, Keith rolled onto his back.

All his life, he'd had trouble sleeping—despite the advice people had given him over the years. He never drank caffeinated beverages after 1800. He had PHANTOM play white noise through the bedroom speakers, drowning out the sound of Rissa's occasional snoring. And although there was a digital-clock display built into his night table, he'd covered its readout with a little square of plasticard slipped into a join between the pieces of wood comprising the table. Staring at a clock, worrying about how late it was, about how little sleep he was going to get before morning came, was counterproductive. Oh, he could see the clock face when standing in the bedroom, and he could always reach over and bend down the plasticard to look at it in bed if he was really curious, but it helped.

Sometimes, that is.

But not tonight.

Tonight, he tossed and turned.

Tonight, he relived the encounter in the corridor with Jag.

Jag. Perfect name for the bastard.

Keith rolled onto his left side.

Jag was currently running a series of professional-development seminars for those *Starplex* staff members who wanted to know more physics; Rissa was running a similar series for those who wanted to learn some more biology.

Keith had always been fascinated by physics. Indeed, while taking a range of sciences in his first year at university, he'd thought seriously about becoming a physicist. So much neat stuff—like the anthropic princi-

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ple, which said that the Universe *had* to give rise to intelligent life. And Schrödinger's cat, a thought experiment that demonstrated that it was the act of observing that actually shaped reality. And all the wonderful twists and turns to Einstein's special and general theories of relativity.

Keith loved Einstein—loved him for his fusion of humanity and intellect, for his wild hair, for his own knight-errant quest to try to put the nuclear genie he'd made possible back into the bottle. Even after choosing sociology as his major, Keith had still kept a poster of the grand old man of physics on his dorm wall. He would enjoy taking some physics seminars . . . but not with Jag. Life was too short for that.

He thought about what Rhombus had said about Waldahud family life—and that turned his mind to his older sister Rosalind and younger brother Brian.

In a way, Roz and Brian had shaped him as much as his genetic make-up had. Because they existed, he was a middle child. Middle children were the bridge-builders, always trying to make connections, to bring groups together. It had always fallen to Keith to organize family events, such as parties for their parents' milestone anniversaries and birthdays, or Christmas gatherings of the clan. And he'd organized his high-school class's twentieth reunion, thrown receptions in his home for colleagues visiting from out of town, supported multicultural and ecumenical groups. Hell, he had spent most of his professional life working to get the Commonwealth off the ground, the ultimate exercise in bridge-building.

Roz and Brian didn't worry about who liked them and who didn't, about whether there was peace between all parties, about networking, about whether people were getting along.

Roz and Brian probably slept well at nights.

Keith switched back to lying on his spine, an arm behind his head.

Maybe it *was* impossible. Maybe humans and Waldahudin could never get along. Maybe they were too different. Or too similar. Or. . . .

Christ, thought Keith. Let it go. Let it go.

He reached over, bent down the piece of plasticard, and looked at the glowing, mocking red digits.

Damn.

Now that they had collected samples of the strange material, it fell to Jag and Rissa, as the two science-division heads, to come up with a research plan. Of course, the next step depended on the nature of the samples. If it turned out to be nothing special, then *Starplex* would continue its quest for whomever activated this shortcut—a life-sciences priority mission. But if the strange material was out of the ordinary, Jag would argue that *Starplex* should stay here to study it, and Rissa's team should take one of *Starplex*'s two diplomatic vessels—either the *Nelson Mandela* or the *Kof Dagrelo em-Stalsh*—to continue the search.

The next morning Jag used the intercom to contact Rissa, who was up in her lab, saying he wanted to see

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her. That could mean only one thing: Jag was intending a preemptive strike to set mission priorities. She took a deep breath, preparing for a fight, and headed for the elevator.

Jag's office had the same floor plan as Rissa's, but he'd decorated it—if that was the word—in Waldahud mud-art. He had three different models of polychairs in front of the desk. Waldahudin disliked anything that was mass produced; by having different models he could at least give the appearance that each was one-of-a-kind. Rissa sat in the polychair in the middle and looked across Jag's wide, painfully neat desk at him. "So," she said. "You've presumably analyzed the samples we collected yesterday. What are the spheres made of?"

The Waldahud shrugged all four shoulders. "I don't know. A small percentage of the sample material is just the regular flotsam of space—carbon grains, hydrogen atoms, and so on. But the principle material is eluding all standard tests. It doesn't combust in oxygen or any other gas, for instance, and as far as I can tell it has no electrical charge at all. Regardless of what I try, I can't knock electrons off it to get positively charged nuclei. Delacorte, up in the chemistry lab, is having a look at a sample now."

"And what about the gravel from between the spheres?" Rissa asked.

Jag's bark had an unusual quality. "I'll show you," he said. They left his office, went down a corridor, and entered an isolation room. "Those are the samples," he said, gesturing with a medial arm at a glass-fronted cubic chamber measuring a meter on a side.

Rissa looked through the window and frowned. "That big one—does it have a flat bottom?"

Jag peered through the window. "Gods—"

The large egg-shaped piece of material had sunk about halfway into the bottom of the chamber, so that only a dome-like part stuck up. Peering more closely, Jag could see that some of the smaller gravel pieces were sinking, too. He pointed with his upper-left first finger as he counted the fragments. Six were gone, presumably sunk beneath the surface of the chamber's bottom. But no holes had been left in their wake.

"It's dropping right through the floor," said Jag. He looked at the ceiling. "Central Computer!"

"Yes?" said PHANTOM.

"I want zero-*g* inside that sample chamber now!"

"Doing so."

"Good—no, wait. Change that! I want five standard *g*s in there, but I want them coming from the chamber's ceiling, not its floor. Got that? I want gravity in there to pull objects up toward the roof."

"Doing so," said PHANTOM.

Rissa and Jag watched, fascinated, as the egg-shaped piece of material started to rise out of the bottom of the chamber. Before it was all the way out, pieces of gravel welled up from beneath the solid floor and fell up toward the ceiling, hitting it not with the ricochet bounce one would expect but more like pebbles falling into tar and beginning to sink.

"Computer, oscillate the gravity un-

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til all the objects are free from the floor and ceiling, then shift to zero-*g*, with the objects floating in the chamber."

"Doing so."

"My word, that's incredible," said Rissa. "The stuff can pass right through other matter."

Jag grunted. "The original samples we tried to collect must have leaked through the probes' walls, pushed out by the force of their acceleration toward *Starplex*."

By bouncing the apparent source of gravity inside the chamber between the top and the bottom, PHANTOM eventually got all the gravel pieces to float freely. But Jag's fur danced when he saw the results of two pieces moving together. He'd expected to see them hit, then bounce off. Instead, when they got to just a few millimeters apart they deflected away from each other.

"Magnetic," said Rissa.

Jag moved his lower shoulders. "No, there's no magnetism at work here—there are no charges present."

There were four articulated arms ending in tractor-beam emitters inside the chamber, and Jag operated all of them in unison, controlling one with each hand. He used one beam to lock onto a piece of translucent gravel a centimeter in diameter, and used a second beam to grab another piece of equal size. He then operated the controls to move the two pieces together. Everything went fine until the chunks were within a very short distance of each other, but then no matter how much power he fed into the tractor beams, he was unable to bring them any closer. "Amazing," said Jag. "There's some sort of force repelling them—a non-magnetic repulsive force. I've never seen anything like it."

"That must be what keeps the haze of gravel from coalescing," said Rissa.

Jag lifted his upper shoulders. "I suppose. The net effect is that the material in the haze between the spheres is bound together gravitationally, but it won't ever coalesce more than it already has."

"But then what keeps these pebbles together? Why doesn't that repulsive force blast them apart?"

"They must be locked chemically. I suspect they were originally formed under great pressure—pressure that defeated the repulsion we're observing. Now that their constituent atoms are bonded, they stay together, but it would take great effort to combine the pebbles into bigger groupings."

"Oh, hell," said Rissa. "You know what I'm thinking. . . ."

Jag's four eyes went wide. "The Slammers! We've only ever seen what their weapon did to one of our probes. Perhaps if they turned it on a world, this might be the result. Quite the doomsday device: not only does it destroy the planet, but it also imparts a force to the rubble to prevent it from ever collecting back together to form another world."

"And now there's an open shortcut leading from here to the Commonwealth worlds. If they were to come through—"

At that moment, Jag's wall beeped, and the elderly face of Cynthia Delacorte appeared on it. "Jag, it's—oh, hi,

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Rissa. Listen, thanks for sending up those samples. Do you know that this stuff sinks into normal matter?"

Jag lifted his upper shoulders. "Incredible, isn't it?"

Delacorte nodded. "I'll say. It's not normal baryonic matter. It's not antimatter, of course. We'd have been blown out of the skies if it were. But where normal protons and neutrons consist of combinations of down quarks and up quarks, this stuff is made of matte quarks and glossy quarks."

Jag's fur danced excitedly. "Really?"

"I've never heard of those kinds of quarks," said Rissa.

Jag made a sound like she was a fool, but Delacorte nodded. "Since the twentieth century, humans have known of six flavors of quarks—up, down, top, bottom, strange, and charmed. In fact, six was the maximum number allowed for under the old Standard Model of physics, so we'd pretty much given up looking for more, which turned out to be a big mistake." She looked pointedly at Jag. "The Waldahudin had only found the same six flavors, too. But when we met the Ibs, they were aware of two more, which we refer to by opposing lusters, glossy and matte. There's no way you can get them by breaking down normal matter, but the Ibs had done unique work pulling matter out of quantum fluctuations. In their experiments, luster quarks were sometimes produced, but only at very, very high temperatures. What we've got here are the first-known naturally occurring luster quarks."

"Incredible," said Jag. "You've noticed the *fardint* things carry no charge? What explains that?"

Delacorte nodded, then looked at Rissa. "Electrons have a charge of negative one unit, up quarks have a positive two-thirds charge, and down quarks have a negative one-third charge. Each neutron is made of two downs quarks and an up, which means the net charge is zip. Meanwhile, each proton consists of one down and two ups, which gives a charge of positive one. Since atoms have equal numbers of protons and electrons, they have an overall neutral charge."

Rissa understood that the explanation had been for her benefit. She nodded at the wall monitor for Delacorte to go on.

"Well, this luster-quark matter consists of what I'm calling para-neutrons and para-protons. Para-neutrons consist of two glossy quarks and one matte, and para-protons consist of a pair of mattes plus a glossy. But neither glossies nor mattes carry any charge whatsoever—so regardless of how you combine them, there's no charge on the nucleus. And without a positive nucleus, there's nothing to attract negatively charged electrons, so a luster-quark atom is *solely* a nucleus; it has no electron orbital shells. The bottom line is that luster matter isn't just electrically neutral. Rather, it's *non*-electrical; it's immune to electromagnetic interactions."

"Gods," said Jag. "That would explain why it can sink into solid objects. It would probably pass through completely unhindered if it weren't for drag caused by the regular-matter

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carbon grains and hydrogen polluting it, and—of course! That explains why we can see it, too. If it were purely luster quarks, it would be invisible, since the reflection and absorption of light depend on vibrating charges. We're just seeing the interstellar dust that's caught gravitationally inside the luster matter, like sand in jelly." He looked at the wall screen. "All right—it doesn't interact electromagnetically. What about the nuclear forces?"

"It *is* affected by both the strong and the weak nuclear force," said Delacorte. "But those forces are so short-range, I doubt we'd get any interaction through them with regular matter except at incredibly high pressures and temperatures."

Jag was quiet for a moment, considering. When he next spoke, his barking was subdued. "It's incredible," he said. "We knew the Slammer weapon could break chemical bonds, but changing regular matter into luster matter is—"

"Slammer weapon?" said Delacorte, her gray eyebrows arching. "Is that what you think produced this stuff? No, I doubt that. It'd take thousands of years for that much dust to be swept up by the spheres. My guess is that we're seeing a natural phenomenon."

"Natural. . . ." said Jag, repeating the bark his translation implant had provided. "Fascinating. What about gravitational effects?"

"Well, luster quarks each mass about 716 times what an electron does; that's about 18 percent more than an up or a down quark. So a luster atom has a little more mass, and therefore produces a little more gravity, than does a normal atom with a comparable number of nucleons. Damned if I know how these luster quarks interact chemically with each other, though."

Jag was pacing back and forth. "All right," he said. "All right—how about this? Let's propose two more fundamental forces on top of the traditional four. Ever since the old Standard Model broke down, we've been looking for additional forces anyway. Say one force is long-range and repulsive—Cervantes and I have already observed that one at work while trying to push pieces of the gravel together with tractor beams. The other force would be medium-range and attractive."

"What does that do for us?" asked Delacorte.

"Well," said Jag, "normal chemistry is the result of orbital overlap of electrons surrounding charged nuclei; there's none of that going on here. But if the medium-range attractive force was stronger than the weak nuclear force, then it could act almost as a 'meta-charge,' making possible a kind of 'meta-chemistry.' It could bind atoms without relying on electromagnetism to do so. Meanwhile, the long-range repulsive force would repel luster quarks from each other. It would only be overwhelmed by the quarks' own gravity when enough mass-density was present to force them together. It's similar to gravity forcing electrons and protons together to make a neutron star despite the degeneracy pressure wanting to keep electrons out of each other's orbitals." He looked at Rissa. "That means we've got 'meta-chemistry' that can conduct possibly

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quite complex reactions at the molecular level, but at the macro level luster matter can only clump together in world-sized masses whose own gravity is enough to overpower the repulsive force."

Delacorte looked impressed. "If you can work out the mechanics of all that, you'll win the Nobel of Kayf-Dukt for sure. It really is incredible—a whole different kind of matter that only interacts slightly with baryonic—"

"Pastark!" barked Jag. "By all the gods, do you know what this is?" His fur was whipping about like wheat in a high wind.

"Tell us," Rissa said at last, irritated.

"We shouldn't be calling it 'luster matter,'" Jag said. "The stuff already has a perfectly good common name." His two right eyes looked at Delacorte's image and his two left at Rissa. "Dark matter!"

"Good God!" said Delacorte. "Good God, I think you're right." She shook her head in wonder. "Dark matter."

"That it is," howled Jag. "It makes up the vast bulk of our Universe, and until now we've never known what it was. This is the find of the century!" His four eyes closed, picturing the glory.

Delta Draconis

"What was Saul Ben-Abraham like?" asked Glass.

Keith looked around the forest simulation, thinking of all the ways he could describe the man who had been his best friend. Tall. Boisterous. A guffaw that could be heard a kilometer away. A guy who could identify any song in three notes. A man who could drink more beer than anyone Keith had ever met—he must have had a bladder the size of Iceland. Finally, Keith settled on, "Hairy."

"I beg your pardon?" said Glass.

"Saul had a great beard," said Keith. "Covered most of his face. And he had this one giant eyebrow, like a chimp had laid its forearm across his head. The first time I ever saw him in shorts, I was amazed. The guy looked like sasquatch."

"Sasquatch?"

"A mythical primate from my part of Earth. I still remember seeing him in shorts for the first time and saying, gee, Saul, you've got hairy legs. He let out that great laugh of his and said, 'Yes—like a man!' I said it was more like ten *men." Keith paused. "God, how I miss him. Friends like that, who mean that much to you, come along perhaps once in a lifetime."*

Glass was quiet for several seconds. "Yes," he said at last. "I suppose that's true."

"Of course," said Keith, "there was more to Saul than just a thick coat of fur. He was brilliant. The only person I've ever met who I thought might be brighter than him is Rissa. Saul was an astronomer. He's the person who discovered the Tau Ceti shortcut, from its footprint in hyperspace. The guy should have won a Nobel prize for that . . . but they don't like to award them posthumously."

"I appreciate your loss," said Glass. "It's as if—oh, excuse me. My reckoner says I've got an incoming thought package. Will you excuse me for a little while?"

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Keith nodded, and Glass took an odd step, sort of sideways, and disappeared. Doubtless he'd gone through a door hidden by the forest simulation filling the docking bay—the only direct visual evidence Keith had had that he wasn't actually back on Earth. Well, if there was a door, Keith wanted to find it. He patted the air in the spot that Glass had disappeared from, but there was nothing.

There had to be a wall somewhere around, though. The bay wasn't that *big. Keith began to walk, figuring he was bound to hit a wall eventually. He continued on for perhaps five hundred meters without encountering any obstruction. Of course, if his—he started to think the word "captor," again, but fought it down and substituted "host" instead—if his host were being clever, he could have manipulated the images to make Keith think we was walking in a straight line when he was really going in a circle.*

Keith decided to rest. As much as he tried to find time to work out in Starplex*'s Earth gym, which had gravity set to a full standard* g*, he'd lost some muscle tone because of all the time he spent in the lighter Rebbello-standard gravity used in the ship's common elements. He really should take Thor Magnor up on his offer of playing handball; Keith and Saul had played the game regularly, but he'd given it up when Saul had died.*

Keith lowered himself to the ground again, which, at this spot, was covered with clover. Keith found it quite comfortable to sit on. He ran his hand through the clover, enjoying the feel of it against his skin, and looked around. It was a remarkable simulation, he thought. So relaxing, so beautiful. He watched some birds moving high overhead, but they were too far away for him to identify the species.

Keith plucked a piece of clover and brought it up to look at. Maybe this was his lucky day; maybe he'd find a four-leaf clover. . . .

What luck! He had!

He plucked a few more pieces, and his jaw dropped.

He pressed his face to the ground, and examined plant after plant.

They were all *four-leaf clovers.*

He brought one up to his face, held between thumb and index finger, and scrutinized it. It seemed like normal clover in almost every way. It even bled a little green plant juice from its severed stem. But each of these clovers had four *leaves. Keith remembered from undergraduate botany that the genus name for clover was* Trifolium*—three leaves. By definition, clover had three leaves, except in the odd mutant individual. But these plants* all *had four distinct oval leaves.*

Keith looked at the white and pink flowers growing from some of the plants. Definitely clover—but four-leaf clover. He shook his head. How could Glass have gotten all the other details right, but have made a mistake such as this? It didn't make any sense.

He looked around again, searching for any other discrepancies. Most of the deciduous trees did indeed seem to be maple—sugar maple, in

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fact, if he wasn't mistaken. And those conifers were jack pine, and the big one a little farther along was a blue spruce. And—

And what kind of bird was that? Sitting in that blue spruce? Surely not a cardinal or a jay. Oh, it had the tufted head crest, but it was emerald green, and its bill was flat and spatulate, unlike that of most songbirds.

It was Earth; no doubt about it. That was Earth's Moon, still sitting high in the daytime sky. And yet, it wasn't quite Earth—some of the details weren't right.

Keith chewed at his lower lip, puzzled. . . .

CHAPTER 7

Jag and Rissa took an elevator up to the bridge, and soon the Waldahud was standing in front of the two rows of workstations, telling his colleagues of the fantastic discovery. "There's a metaphor that's been carried by the current for years," he barked, "that visible matter is just froth on an inky ocean of dark matter. We knew the dark matter was there because of its gravitational effects, but we've never seen it—until now. Those spheres out there, and the gravel fog between them, are made out of dark matter."

Lianne let out a low whistle. Keith raised an eyebrow. He knew a bit about dark matter, of course. CalTech astronomer Fritz Zwicky had deduced its existence back in 1933, through observations of the galaxies in the Virgo Cluster. Those galaxies were rotating around each other so quickly that if the visible stars were the only major source of mass present, the whole thing should have flung apart long ago. Subsequent studies showed that almost every large structure in the Universe—including our Milky Way Galaxy—behaved as if there were far more mass present than could be accounted for by the suns and any reasonable number of attendant planets. Some previously undetected matter, dubbed "dark matter" because it was apparently neither luminous nor highly reflective, accounted for over 90 percent of the gravity in the Universe.

As usual, Thorald Magnor had his large feet up on his console, and his thick fingers interlaced behind his head, buried in his red hair. "I thought we'd already discovered what dark matter was," he said.

"Only part of it," said Jag, lifting two of his four hands. "We've long known that baryonic matter—matter made up of protons and neutrons—accounts for less than 10 percent of the mass of the Universe. In 2037, we discovered that the ubiquitous tau neutrino has a very slight mass—about seven electron-volts' worth. And we found that the muon neutrino also has a trifling mass, about three one-thousandths of an electron-volt. Since these two types of neutrinos are so abundant, in total they account for about three or four times more mass than all the baryons do. But that still left us with as much as two-thirds of the Universe's mass unaccounted for—until now."

"What makes you think the stuff out there is dark matter?" Keith asked.

"Well," said Jag, "it isn't normal matter; that much is certain." Although

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he was trying to hide it, Jag was holding on to the beveled edge of Thor's console with one hand so that he wouldn't drop down onto four legs. *Starplex* operated on a four-shift cycle as a concession to the Waldahudin, who came from a world with a short day, but Jag had been working overtime. "In early dark-matter studies, there were two candidates for the material comprising it, named WIMPs and MACHOs by human astronomers—all of whom should have to swim in a river of urine, by the way. WIMPs are 'weakly interacting massive particles'—you see the gibberish foisted upon us in search of these silly acronyms? Anyway, the tau and muon neutrinos turned out to be WIMPs."

"And MACHOs?" asked Keith.

"'Massive compact halo objects,'" said Jag. "The 'halo' is the sphere of dark matter that has a galaxy at its center. The 'massive compact objects' were thought to be billions of Jupiter-sized bodies not associated with any particular star—a fog of gaseous worlds through which the luminous material of the Galaxy moves."

Lianne was leaning forward, chin resting on her hand. "But if the Universe really were permeated with—with MACHOs," she asked, "wouldn't we have detected them by now?"

Jag turned to her. "Even Jupiter-sized objects are puny on the cosmic scale. And since they're non-luminous, the only way we would see them is if one wandered in front of a star we happened to be observing. Still, the effect would be minor: just a slight gravitational lensing of the star's light, causing a temporary brightening. Such events have occasionally been seen; the oldest recorded observation of one was made by human astronomers in 1993. But even if space were lousy with MACHOs—enough so that they made up two-thirds of all the mass in the Universe—only one out of every five million stars you could observe at any given moment would likely be undergoing gravitational lensing due to one passing by." He gestured toward the twinkling part of the starfield. "We only see gross effects here because we're so close to the field of dark matter, and because the dark matter itself is transparent. We're actually just seeing regular space dust, sprinkled throughout the dark-matter objects."

Keith looked at Rissa, his eyebrows raised. She made no objection. "Well," said the director, "this certainly seems to be a major discovery, worthy of further—"

"Forgive the interruption," said Rhombus, "but I'm detecting a tachyon pulse." Rhombus rotated the starfield hologram surrounding the bridge to bring the shortcut front and center; the effect on Keith's stomach was similar to what he experienced in a planetarium when the operator was trying to demonstrate that learning could be fun. Jag quickly took his seat on Keith's left. The shortcut was a pinprick of green—the color of whatever was coming through it—surrounded by the usual ring of violet Soderstrom radiation.

"Is it a Commonwealth ship?" Keith asked.

"No," said Rhombus. "There's no transponder signal of any kind." The

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green spot continued to grow. "Incredulous: that is bright"—PHANTOM's stilted translation of the words that were flashing over Rhombus's mantle. But the Ib was right. The shortcut was the brightest object in the sky, exceeding even the A-class star Jag had spotted earlier.

"Let's give it lots of room, whatever it is," said Keith. "Thor, start backing us away."

"Doing so."

Keith looked to his left. "Jag, spectral analysis."

The Waldahud read from one of his monitors. "Scanning. Hydrogen, helium, carbon, nitrogen, oxygen, neon, magnesium, silicon, iron. . . ."

"It looks pure green," said Keith. "Could it be a laser?"

Jag turned his two right eyes to look at the director, while keeping his other two focused on his instruments. "No. There's nothing coherent about that light."

The fiery green pinprick was growing wider; it had become a fiercely bright circle several meters in diameter.

"How about a fusion exhaust?" asked Lianne. "Could it be a ship coming out of the shortcut tail first, as if it were decelerating?"

Jag consulted more readouts. "It certainly *is* a fusion signature," he said. "But it would have to be a *very* powerful engine."

Keith left his console and walked over to stand just behind Rhombus. "Any chance of contacting that ship?"

One of Rhombus's manipulatory ropes whipped out to touch a control. "Forgive me, but not on conventional radio. The thing is putting out an enormous amount of EMI. A hyperspace radio link might work, but there's no way of knowing which quantized level they use for communication."

"Start at the lowest and work your way up," Keith said. "Standard prime-number sequences."

Another flick of a rope. "Transmitting. But it would literally take forever to try every level."

Keith turned around and faced Rissa. "Looks like you might get your first-contact opportunity after all." He turned back to look at the shortcut. "Christ, that's bright." Every object on the bridge that wasn't swathed in the hologram was bathed in green light now. Although no shadows fell on the invisible floor, the staff members were all casting harsh ones on the seating gallery behind the workstations.

"It's even brighter than it looks," said Jag. "The camera is filtering most of it."

"What the hell could it be?" Keith asked, looking at Jag.

"Whatever it is," said Jag, "it's streaming out a lot of charged particles—could be a particle-beam weapon." The green circle continued to expand. "Diameter is now one hundred and ten meters," said Jag. "One fifty." His barking grew softer, incredulous. "Two fifty. Five hundred. A full kilometer. *Two kilometers.*"

Keith turned back to the flaring image in the hologram. "Jesus," he said, bringing an arm up to shield his eyes.

Slapping of ropes from Rhombus—an Ibese scream. "Profuse apologies,"

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he said a moment later as the display darkened somewhat. "The object is brighter than the automatic compensators are designed to deal with. I shall henceforth monitor the display directly."

The green circle kept expanding at a great rate. Its edges were coruscating with violet Soderstrom discharges—a pyrotechnical halo around the vast green center. The central area still seemed to be a flat circle.

"Temperature is about 12,000 Kelvin," said Jag.

"That's *hot,*" said Rissa. "What in God's name is it?"

An alarm started sounding, warbling high and low. "Radiation warning!" shouted Lianne. She wheeled to face Keith. "Recommended action: move *Starplex.*"

"Right," Keith said, sprinting back to his command station. "Thor, pick up the pace. Put us another fifty thousand klicks from the shortcut." He glanced at his astrogation readout. "Course 210 degrees by 45 degrees. Use thrusters only; I don't want to drop into hyperspace until we know what that thing is."

"As you say, boss," said Thor, hands flying over his instruments.

The apparent growth of the green circle slowed, but it was still getting larger; its expansion rate was exceeding *Starplex*'s maneuvering speed.

"I didn't know a shortcut could open that wide," said Rhombus. "Jag, just what exactly is coming through it?"

Both sets of Jag's shoulders rose and fell. "Unknown. The spectral analysis is unusual—lots of heavy-element Fraunhofer absorption lines. It matches nothing in our database." He paused. "If it *is* a fusion exhaust, the ship must be gigantic."

"It looks perfectly flat," said Rissa. "How can it keep expanding as a circle?"

"The apparent expansion is caused by the opening up of the shortcut aperture," said Jag. "They open at a finite speed, and, when touched by a flat surface, an aperture will take on a circular shape until the edges are reached." He used his left eyes to glance at a readout. "The rate at which the aperture is opening is increasing, although at an uneven rate."

The halo of violet, representing the edges of the portal, was just the faintest border around the vast circle, like a matte-line around a spaceship model in an old-fashioned SF movie.

"How big is it now?" Keith asked.

Jag was evidently getting tired of answering that question. He touched keys on his console and a trio of color-coded rulers demarcated in different units formed a glowing three-quarters frame around the green circle. It now measured four hundred and fifty kilometers in diameter.

"Radiation levels are increasing rapidly," said Lianne.

"Thor, double our retreat speed," Keith said. "Can our force screens handle this?"

Lianne was consulting a set of readouts. She shook her head. "Not if it gets much bigger."

The warbling sound was continuing in the background. "Turn that damned alarm off," Keith said. He looked at the Waldahud. "Jag?"

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"It's flat," Jag said. "Like a wall of flame. Diameter is now over a thousand kilometers. Thirteen hundred . . . seventeen hundred. . . ."

The emerald light dominated the sky. The humans brought up hands to shield their eyes again.

Suddenly, a streamer of green fire shot out of the wall, like a neon whiplash against the night. It continued to stretch out until it had extended over fifty thousand kilometers from the shortcut.

"My God . . ." said Rissa.

"Tell me that's *not* a weapon," said Jag, rising to his feet, and standing with both sets of arms crossed behind his back. "We would have been incinerated if we hadn't moved the ship."

"Could it—could it be the Slammers?" asked Lianne.

The green streamer was now falling back toward the vast luminescent circle of the shortcut. As it did so, it broke up into fiery segments, each thousands of kilometers long.

"Thor, prepare to go into hyperdrive on my order," Keith said.

"All stations, secure for hyperdrive," said Lianne's voice over the loudspeakers.

"Is it a forcefield of some kind?" asked Rissa.

"Unlikely," said Jag.

"If that *is* a ship's exhaust," Keith said, "it must have the biggest goddamn ramscoop in history attached to the other end."

"Diameter is eight thousand kilometers," said Jag. He had already recalibrated the units on the scale bars twice. "Ten thousand. . . ."

"Thor, thirty seconds to hyperdrive!"

"All stations, alert," said Lianne. "Hyperdrive in twenty-five seconds, mark."

Another tongue of green flame shot out of the widening circle. "Hyperdrive in fifteen seconds, mark," said Lianne.

"Sweet Jesus, it's huge," Rissa said, under her breath.

"Hyperdrive in five sec—hyperdrive initialization canceled! Automatic override!"

"What? Why?" Keith looked at the pair of computer eyes mounted on his workstation. "PHANTOM, what's happening?"

"Gravity well is too steep for safe hyperspatial insertion," replied the computer.

"*Gravity well?* We're in open space!"

"Oh, Gods," said Jag. "*It's big enough to curve space-time.*" He moved out from behind his console and jogged in front of the cluster of work stations. "Reduce display brightness by half."

Rhombus's ropes flicked. The view of the giant green circle dimmed, but it was still flaring, overexposed.

"Halve it again," snapped Jag.

The view grew dimmer. Jag was trying to look at it, but it was still too bright for eyes that had evolved under a dim red sun. "Once more," he said.

The view darkened further—and suddenly there was detail visible on the green surface: a granularity of lighter and darker shades. . . .

"That's not a ship," said Jag, his own voice, audible beneath PHANTOM's translation, the staccato barking of

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Waldahud astonishment. "It's a *star.*"

"A *green* star?" said Rissa, amazed. "There's no such thing."

"Thor," Keith snapped, "full thruster power—perpendicular course away from the shortcut. Move!"

The alarm began to warble again. "Level-two radiation warning!" shouted Lianne overtop of it.

"Force screens to maximum," Keith snapped.

"Can't do both, boss," shouted Thor. "Full thrusters can't be combined with maximum screens."

"Priority to thrusters, then! Get us out of here!"

"If that's a star," said Rissa, "we're *way* too close, aren't we?" She looked at Jag, who said nothing. "Aren't we?" she asked again.

Jag lifted his upper shoulders. "Way, way too close," he said softly.

"If the radiation doesn't fry us," said Rissa, "the heat will."

"Thor, can't you get any more speed?" Keith said.

"No can do, boss. The local gravity well is steepening rapidly."

"Would we do better to abandon the mother ship?" asked Lianne. "Perhaps our smaller ships could escape more easily?"

"Forgive me, but no," said Rhombus. "Beside the fact that we don't have enough auxiliary vessels to evacuate everyone, only a few of them are outfitted with shielding for close approaches to stars."

Lianne had her head tilted to one side; listening to private communications over her ear implant. "Director, we have panicked messages coming in from all over the ship."

"Standard radiation precautions," snapped Keith.

"Those will be inadequate," said Jag softly, as he moved back to his workstation.

Keith looked over at Rissa. One of her monitors was displaying plans for *Starplex,* showing the two mutually perpendicular diamonds intersecting the wide central disk. "What happens," she said, turning to him, "if we rotate *Starplex* so that the ocean deck is at a right angle to our line of travel?"

"What difference will that make?" asked Keith.

"We could use the seawater as radiation shielding. The ocean is filled to a depth of twenty-five meters. That's a lot of insulation."

Lights on Rhombus's web winked on and off. "It would certainly help—everyone who isn't on or below the ocean deck, that is."

Lianne spoke up. "We'll *all* be fried unless we do something."

Keith nodded. "Thor, rotate *Starplex* as described."

"ACS jets firing."

"Lianne, devise a plan to evacuate all personnel from decks thirty-one through seventy."

She nodded.

"PHANTOM, intercom now!"

"Intercom on," said PHANTOM.

"Everyone—quickly. This is Director Lansing. Following instructions from Internal-Ops Manager Karendaughter, evacuate decks thirty-one through seventy. Get out of the engineering torus, out of the docking bays, out of the cargo holds, and out of all four lower habitat modules. Everyone move into the upper habitat

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modules. All dolphins—either get out of the ocean deck altogether, or swim up to the surface of the ocean and stay there. Everyone, move in an orderly fashion—but move! PHANTOM, end, translate, and loop."

In the holo display, the surface of the star was bulging out of the circular shortcut opening. "The shortcut-aperture expansion rate is increasing rapidly," said Jag. "It seemed to take a while to get going, probably because the star was essentially flat at first, but now that the surface is showing curvature, the thing is opening more quickly. Diameter is now 110,000 kilometers."

"Radiation is increasing rapidly as more of the surface comes through," said Lianne. "And if it shoots another prominence in our direction, we'll be cinderized."

"Evacuation status," snapped Keith.

Lianne pushed buttons and twenty-four square images appeared, replacing part of the starscape bubble. Each showed a different view through PHANTOM's eyes, and the scenes kept shifting, cycling through the computer's various cameras.

A corridor—level fifty-eight, according to the superimposed status line: six Ibs rapidly rolling forward.

An intersection: three human women in track suits hurrying toward the camera from one direction, and two Waldahudin and a human male rushing in from the other direction.

The zero-*g* part of the central shaft: people using the handholds to shoot themselves upward.

A vertical water tube, with three dolphins swimming up it.

An elevator car, with a Waldahud holding the door open with one arm and urging passengers in with the other three.

Another elevator car, containing an Ib surrounded by a dozen humans.

"Even with everyone above the ocean deck," said Lianne, "I don't think we're going to have enough radiation shielding."

"Wait!" said Thor. "What about going behind the shortcut?"

"Eh?" said Rhombus—or, at least, that's the sound PHANTOM gave to the little ripple of lights that passed over his mantle.

"The shortcut's a circular hole," said Thor, looking over his shoulder at Keith. "The star is emerging from it. The rear part of the shortcut is a flat, empty circle—a black void in the shape of whatever's passing through it. If we're behind the shortcut, we'll be protected—at least for a while."

Jag slapped all four of his hands against his console. "He's right!"

Keith nodded. "Do it, Thor. Alter course to put us in the lee of the shortcut, keeping the bottom of the ocean deck facing the emerging star."

"Executing," said Thor. "But it'll take a while to get there." In the spherical holo display encompassing the bridge, the brilliant circular profile of the star slowly became a green dome as Thor maneuvered the ship.

"Talldorsal to Lansing!" A high-pitched dolphin voice over the intercom, with splashing in the background.

"Open. Lansing here."

"Thor's not moving the ship in a straight line. We're getting *tides* on

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the ocean deck."

"Lianne?" Keith said, and the twenty-four views of the evacuation all changed to different angles on the ocean. Sea water was sloshing up to the holographic ceiling on the port side, real waves touching fake clouds, forcing all the dolphins to the starboard so that they could breathe.

"Damn," said Thor. "Hadn't thought about that. I'll rotate the ship around its axis as we move. With luck, I should be able to keep all the forces balanced. Sorry!"

As *Starplex* continued to move, the bulging dome of the green star became progressively eclipsed by the featureless black circular backside of the shortcut. And then, at last, the green disappeared; *Starplex* was in the shortcut's lee. The only evidence for the emerging star was the emerald cast on the dark-matter field beyond it. Even the ring of Soderstrom radiation was invisible back here; it, after all, was caused by tachyons spilling out of the shortcut, heading in the opposite direction. The black circle continued to grow, though, blotting out more and more background stars. Its diameter was now 800,000 kilometers.

"Can you extrapolate how big the star is going to get, based on the curvature we observed on the other side?" Keith asked Jag.

"It's not yet halfway through," Jag replied, "and it's oblate from high-speed rotation. Best guess? One-point-five million kilometers."

"Thor, any chance of the hyperdrive?" Keith asked.

Thor spoke into the hologram of Keith floating above his console rim. "Not yet. We'd have to be at least seventy million klicks from the star's center before space would be flat enough to engage it. I estimate we'll reach that distance in eleven hours."

"Hours! How long till the star's equator passes through the shortcut?"

"Perhaps five minutes," said Jag.

"Evacuation status?"

"One hundred and ninety people are still below the ocean deck," said Lianne.

"Will we make it?" Keith asked her.

"I'm not—"

"Red light on thruster number six," shouted Thor. "It's overheating."

"*Great,*" Keith said. "Do you need to take it off-line?"

"Not yet," said Thor. "I'm injecting repair nanotechs into its intercoolers; they may be able to correct the problem."

"The green star's equator is about to pass through the shortcut," said Jag.

A portion of the holographic display changed to a schematic representation of what was happening. At the left was the bulging hemisphere of the part of the star that had already protruded from the shortcut. The shortcut itself was seen from the side as a vertical line. Behind that, and receding away from it, was the diamond shaped profile of *Starplex*. As the equator passed out of the shortcut, the hole the shortcut made in space started shrinking, and photons and charged particles from the star began spilling backward. The edges of the radiation backwash were like the hands of a clock starting at noon

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and six and converging toward three o'clock.

Thor pushed *Starplex* as hard as he could. Keith could see constellations of yellow warning indicators lighting up on the pilot's panel. The ship continued to climb out of the star's gravity well, its escape tunnel narrowing as the shortcut shrank in size.

"Lansing!" shouted Jag. "The dark-matter field is *moving*—moving away from the star."

"Could it be because of that repulsive force you mentioned?"

Jag moved both sets of shoulders. "It's not the kind of effect I'd predict, but—"

"Lower deck evacuation now complete," said Lianne, swinging around to face the director.

"Even so," said Thor, "we're going to take one hell of a big radiation kick when that backwash hits us."

Finally, the star finished emerging, and the shortcut disappeared. At that point, Thor switched all power from the engines to the force screens, trying to deflect as much of the incoming radiation as possible. *Starplex* continued to travel under momentum. The radiation alarm began to warble again.

"Are we far enough away?" Keith asked. Thor was too busy with the controls to answer. "Are we far enough away?" he asked again.

Jag did some calculations. "I think so," he said, "but only because we're using the ocean deck as shielding. Otherwise, we would all have taken a lethal dose."

"All right," Keith said. "Let's continue on until we're at a safe distance. Lianne, draw up a new duty roster that makes minimal use of cetaceans, and put any non-essential dolphins into medical hibernation until we can replace the water on the ocean deck. At the rate the star is receding from the shortcut, it'll be days before we can approach the portal safely." He paused, then: "Good work, everyone. Rhombus, what's the status of our docking bays?"

"They should still be usable. Their walls are heavily shielded against radiation leakage, in case a ship crashes or explodes in them."

"Good," said Keith. "Thor, let me know when we're an acceptable distance from that star." He turned to the Waldahud. "Jag, you should go have a close look at it. I want to know exactly where it came from and why it's here."

CHAPTER 8

It had taken a long time for humans to decipher dolphin speech. When they finally did so, delphinese names turned out to be sonargrams of individual dolphins, with their most unusual physical characteristics exaggerated. It was no surprise, then, that the only form of human art dolphins really enjoyed was political cartooning.

One of *Starplex*'s best probeship pilots was a dolphin whose English name was Longbottle—a poor substitute for the song of trills and clicks that painted a caricature of him for his kinfolk, emphasizing his mighty snout.

Longbottle's favorite probeship was the *Rum Runner,* a bronze wedge twenty meters long and ten wide. A

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water tank ran down the ship's axis. To the left and right were separate air-filled habitats that joined at the rear in a U-shape with an airlock between them. The port side was normally kept to human standards; the starboard was set to cooler Waldahud conditions.

To pilot the vessel, Longbottle let small free-floating sensor drones clamp onto his flukes and pectoral fins. The ship had hundreds of attitude-control jets that allowed it to move in direct approximation of the dolphin's own movements in his tank. Such a technique was extraordinarily wasteful of fuel—so much so that the Waldahudin had refused to bid on the contract to build these vessels—but it provided incredible maneuverability and, according to Longbottle, was an absolute joy to fly.

Although the *Rum Runner* could operate away from *Starplex* for weeks at a time, on this mission it would be gone for less than a day, and the crew would consist of just Longbottle and Jag.

The *Rum Runner* was normally stored in docking bay seven, one of five that had locks leading through the engineering torus to the ocean deck. The ship was clamped to the deck's wall, and three access tubes at shallow angles entered its rooftop hatches.

Once Longbottle and Jag were aboard, the segmented docking-bay door moved up into the roof. Longbottle was famous for his theatrical launches. He zoomed the ship out of the bay, then rolled and arched in his tank, taking the *Rum Runner* on a breathtaking warm-up flight past all the docking-bay doors, swinging in a great circle around the central disk. He then rolled to one side in his tank, and the ship made a wide arc—looking for all the world as though it were banking in the vacuum of space.

Jag was getting impatient, but Longbottle, like all dolphins, was oblivious to that. He did a series of turns and flips in his tank, and the ship responded in kind. The gravity plates under Jag's compartment compensated completely for the movements, but in his water-filled tube, Longbottle could feel the ship as if it were an extension of his own body.

Finally, when he'd had enough fun, Longbottle set off on a wildly curving path—again, wasteful of energy, but so much more interesting than the straight lines and precise arcs of normal celestial mechanics.

The green star dominated the sky, even though its surface was now thirty million kilometers distant. The *Rum Runner* had much better force screens and physical shielding than did *Starplex* itself; it could make a very close passage. Under Longbottle's fanciful guidance, the ship dived in, skimming the vast orb from just 100,000 kilometers above its photosphere. Scoops on the ship's leading edge sucked in samples of stellar atmosphere.

"Greenness of this star a bafflement to me," said Longbottle, through the hydrophone in his tank. Like most dolphins, Longbottle could approximate the sounds of both English and Waldahudar (although with mangled syntax—there was no such thing as appropriate word order in cetacean

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grammar). The computer simply processed those sounds to make them intelligible; it would only switch over to translation mode if a dolphin was actually speaking in delphinese.

Jag grunted. "I'm puzzled, too. Its surface temperature is 12,000 degrees. The *fardint* thing should be blue or white, not green. The spectral analysis doesn't make any sense either. I've never seen such high concentrations of heavy elements in a star."

"Damaged perhaps by passage through shortcut?" asked Longbottle, twisting in his tank so that the ship would roll slowly around its axis. Even with extra shielding, it wasn't safe to keep the same side facing the star.

Jag grunted again. "I suppose that's possible. Most of the star's chromosphere and corona were probably scraped off during passage through the shortcut. The shortcut's lips clamped down on the photosphere, stripping away the rarefied gas above. Still, all previous tests have shown zero structural change in objects passing through a shortcut. Of course, nothing this big has ever gone through one before."

The *Rum Runner*'s viewscreens were filled to the edges with flaming green; the physical windows had all turned opaque. "Take us in once around the star's equator," said Jag, "then do a polar loop. It's possible that the star's structure isn't uniform. Before I get too worked up over these absorption lines, I want to be sure the spectra are the same all over."

It took almost five hours at one one-thousandth of light speed to complete the five-million-kilometer sweep around the equator, and another five to do the loop from pole to pole. Longbottle kept the *Rum Runner* corkscrewing all the while. Jag's eyes were glued to his scanning equipment, watching the dark vertical absorption lines. He kept muttering to himself, "Silt in the water, silt in the water"—the truth remained hidden.

Jag had no trouble measuring the star's mass from its footprint in hyperspace; it was somewhat heavier than he'd expected. Except for the color, the star's surface was fairly typical, consisting of tightly packed beads of light and dark caused by convection cells in the photosphere. It even had sunspots, but unlike those of other stars, these were all connected in dumbbell shapes. It was, without doubt, a star—but it was also unlike any star Jag had ever seen before.

Finally, the fly-bys were complete. "Ready home to go?" asked Longbottle.

Jag lifted all four arms in a gesture of resignation. "Yes."

"Mystery solved?"

"No. A star like this should simply not exist."

The *Rum Runner* swept back toward *Starplex,* Jag muttering over his data for the entire journey.

Keith lay in bed next to his wife, unable to sleep. He looked over at Rissa's form in the darkness, watched the thin sheet covering her rise and fall in time with her breathing.

She deserved better, he thought. He exhaled, trying to force the worries

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out of himself with the escaping breath, and conjured up images of happier times.

Rissa had dark eyes that turned into upward-arching crescents when she smiled. Her mouth was small, but her lips were full—half as tall as they were wide. Her mother had been Italian; her father, Spanish. She had inherited her lustrous dark hair and his fiery eyes. In his forty-six years of life, Keith Lansing had never met anyone who looked more appealing by candlelight than Rissa.

When they'd first met, in 2070, he'd been twenty-two and she'd been twenty, with a wonderfully curvy figure. Of course, her body shape was changing in natural ways as she aged; she was still in fine condition, but the proportions had shifted. Back then, Keith couldn't have imagined finding a woman of forty-four attractive, but, to his infinite surprise, his tastes had altered as the years passed, and although two decades of marriage had doubtless dulled his immediate reaction to her, when he saw Rissa in an unusual way—in a new suit, or stretching to reach something on a top shelf, or with her hair swept in a different manner—she could still take his breath away.

And yet. . . .

And yet, Keith was aware that time was taking its toll on him. His hair was departing. Oh, there were "cures" for that—imagine suggesting that something as natural as male-pattern baldness required a cure!—but to employ them seemed vain and foolish. Besides, middle-aged scientists were supposed to be bald. It was in the rule book somewhere.

Keith's father had had a full head of dark hair up until when he'd been killed at age fifty-five; Keith wondered now whether he'd used a hair-restorer. But for Keith to do something like that would be silly.

He remembered Mandy Lee, a holovid star he'd been infatuated with as a twelve-year-old boy. Back then, nothing had been more exciting to him than large breasts on a woman, probably because none of the girls in his class had them yet; they were a symbol of the forbidden alien world of adult sexuality. Well, Mandy—dubbed "the binary star-system" by some wag at *HV Guide*—was famous for her physique. But Keith had lost all interest in her when he'd found out that her breasts were fake; he couldn't look at her without imagining the implants beneath the swelling alabaster skin and the surgical scars (even though he knew, of course, the anabolizing laser scalpels would have left no marks at all). Well, he'd be damned if he'd turn his head into a fake; he'd be damned if he'd let people looking at him think, hey, the guy's really bald, you know, . . .

And so there they were, Rissa Cervantes and Keith Lansing: still in love, if not in the passionate way of their youth, in what was ultimately a more satisfying, more relaxing fashion.

And yet—

And yet, dammit, he'd just turned forty-six. He was aging, balding, graying, and hadn't been with another woman since his three—such a small number!—awkward encounters in high school and at university. Three,

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plus Rissa—a total of four. An average of less than one a decade. *Christ,* he thought, *even a Waldahud could count my partners on the fingers of one hand.*

Keith knew he shouldn't think about such things, knew that what he and Clarissa had was something most people never really achieved: a love affair that grew and evolved as they aged, a relationship that was solid and secure and warm.

And yet—

And yet there was Lianne Karen-daughter. Like Mandy Lee, the very symbol of beauty in his youth, Lianne had exquisite Asian features; something about Asian women had always appealed to Keith. He didn't know how old Lianne was, but there was no doubt that she was younger than Rissa. Of course, as ship's director, Keith could easily access Lianne's personnel records, but he was afraid to do so. For God's sake, she might be as young as thirty. Lianne had come aboard the last time *Starplex* had passed by Tau Ceti, and now, as Internal-Operations manager, she and Keith often spent hours together on the bridge. And yet, to his surprise, no matter how much time he spent with her, he always wished it were more.

He hadn't done anything foolish yet. Indeed, he thought he had everything under control. Still, he'd always been an introspective sort; he wasn't blind to what was going on. Mid-life crisis, the fear that he was no longer virile. And what better way to dispel that notion than by bedding a beautiful, young woman?

Idle fantasies. Of course, of course.

He rolled onto his side, facing away from Rissa, tucking himself into a semi-fetal position. He didn't want to do anything that would hurt Rissa. But if she never learned about it—

Christ, man, get a grip. She'd find out for sure. How would he face her after that? And their son Saul? How would he face him? He'd seen his son beam at him with pride, yell at him in fury, but he'd never seen him look at him with disgust.

If only he could get some sleep. If only he could stop tormenting himself.

He stared into the darkness, eyes wide open.

Once the *Rum Runner* had docked, Longbottle went off to eat, and Jag returned to the bridge. The Waldahud was now keeping erect by use of an intricately carved cane—still better than reverting to four legs. Keith, Rissa, Thor, and Lianne had all had a night's sleep, and Rhombus—well, Ibs didn't sleep, a fact which made their long life spans seem doubly unfair. Jag usually stood in front of the six workstations to give reports, but this time he walked back to the seating gallery and collapsed into the center chair, letting the others rotate their stations to face him.

Keith looked at the Waldahud expectantly. "Well?"

Jag marshaled his thoughts a moment, then began to bark. "As some of you know, stars are divided into three broad age categories. First-generation stars are the oldest in the Universe, and consist almost entirely of hydrogen and helium, the two original ele-

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ments. Less than 0.02 percent of their composition is heavier atoms, and those, of course, were produced internally through the stars' own fusion processes. When first-gens go nova or supernova, the interstellar dust clouds are enriched with these heavier elements. Since second-generation stars coalesced from such clouds, a full percent or a bit more of a second-gen's mass comes from metals—'metals' in this context meaning elements heavier than helium. Third-generation stars are even more recent; the suns of all the Commonwealth homeworlds are third-gens, as are all stars being born today, although, of course, some first-gens and a lot of second-gens are still around, too. Third gens consist of about 2 percent metals."

Jag paused for a moment, and looked from face to face in the room. "Well," he said, "that star"—he gestured with one of his medial arms at the green orb in the holo sphere—"has about *8* percent of its mass as metals, four times as much as even a typical third-gen. The thing has enough iron in it that you could actually *mine* it."

"What about the green color?" asked Keith.

"It's not really green, of course, any more than a so-called red star is actually red. Almost all stars are white, with just a hint of color." He gestured with his medial limbs at the starfield around them. "PHANTOM routinely colorizes the stars in our holo bubble, assigning them colors based on their Hertzsprung-Russell categories. The star out there just has a greenish tinge. The absorption-line blanketing due to its metal content is stronger than the backwarming, and that weakens the star's output in the blue and ultraviolet. The result is more of the star's light coming out in the green region of the spectrum." His fur danced. "I would have said a star with so much metal content would be impossible in our Universe at its present age if I hadn't seen one with my own four eyes. It must have formed under very peculiar local conditions, and—"

"Forgive the interruption, good Jag," said Rhombus, "but I'm detecting a tachyon pulse."

Keith swiveled in his chair, facing the shortcut.

"Gods," said Jag, rising to his feet. "Most stars are part of *multiple* star systems—"

"We can't take another close passage," said Lianne. "We'll—"

But the shortcut had already stopped expanding. A small object had popped through. The gateway had grown to only seventy centimeters in diameter before collapsing down to an invisible point.

"It's a watson," announced Rhombus, an automated communications buoy. "Its transponder says it's from Grand Central Station."

"Trigger playback," Keith said.

"The message is in Russian," said Rhombus.

"PHANTOM, translate."

The central computer's voice filled the room. "Valentina Ilianov, Provost, New Beijing Colony, to Keith Lansing, commander, *Starplex*. An M-class red-dwarf star has erupted from the Tau Ceti shortcut. Fortunately, it emerged

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heading away from Tau Ceti, rather than toward it. So far, no real damage has been done, although we had trouble piloting this watson past the star and into the portal. This is our third attempt to reach you. We did manage to contact the astrophysics center on Rehbollo for advice, and they had the incredible news that a star has popped out of the shortcut near them as well—a blue B-class star, in their case. I am now contacting all other active shortcuts to find out just how widespread this phenomenon is. End of message."

Keith looked around the bridge, bathed in green starlight. "Christ Jesus," he said. ■

TO BE CONTINUED IN THE NEXT ISSUE.

Causality

Just because you saw me do it,
does not prove I was the cause.
Bring in the jury,
throw out the laws.

Method, motive, and opportunity
we cast aside like fools,
because we live in a universe
without linear rules.

by Carolyn Clink

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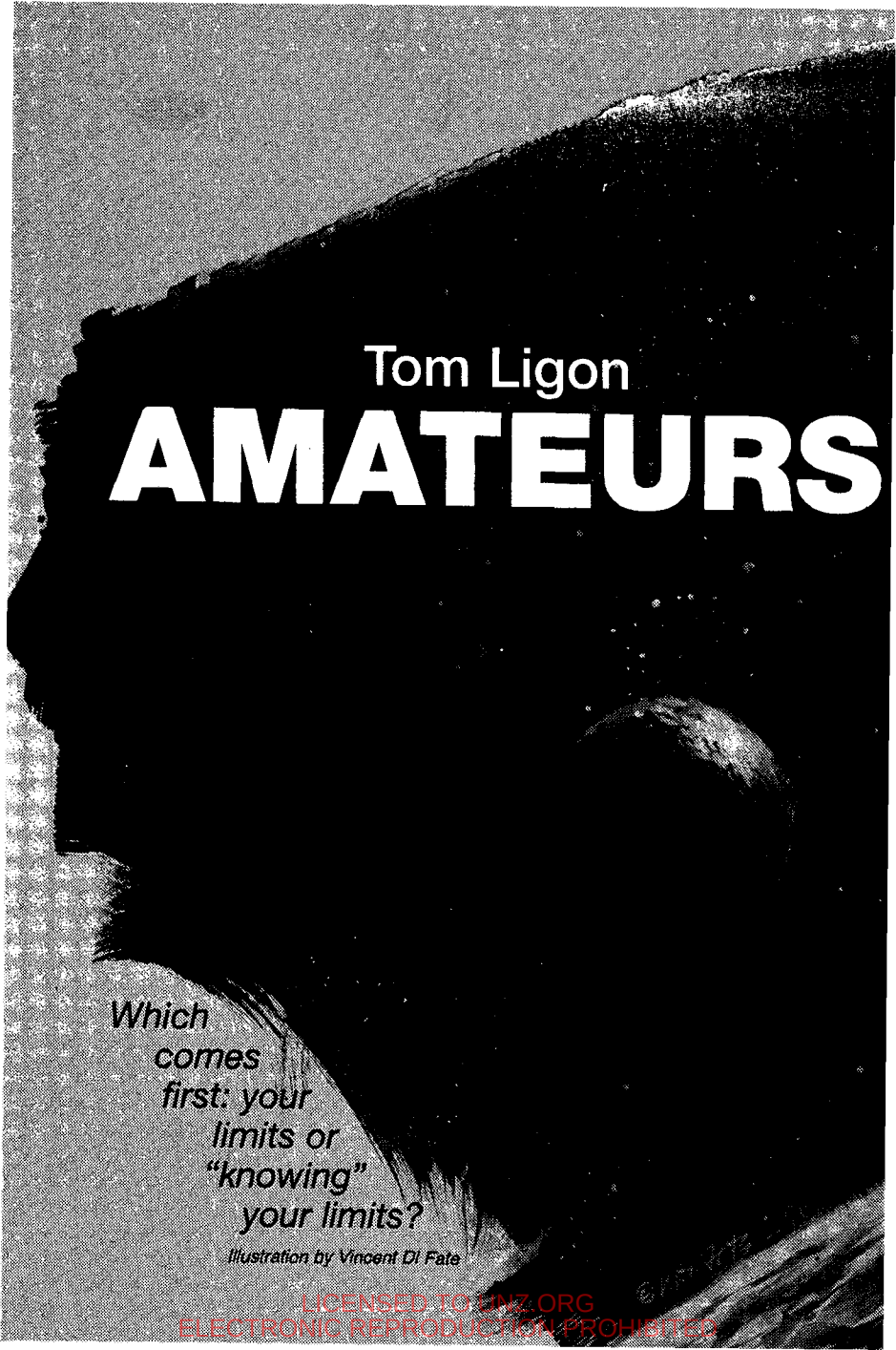

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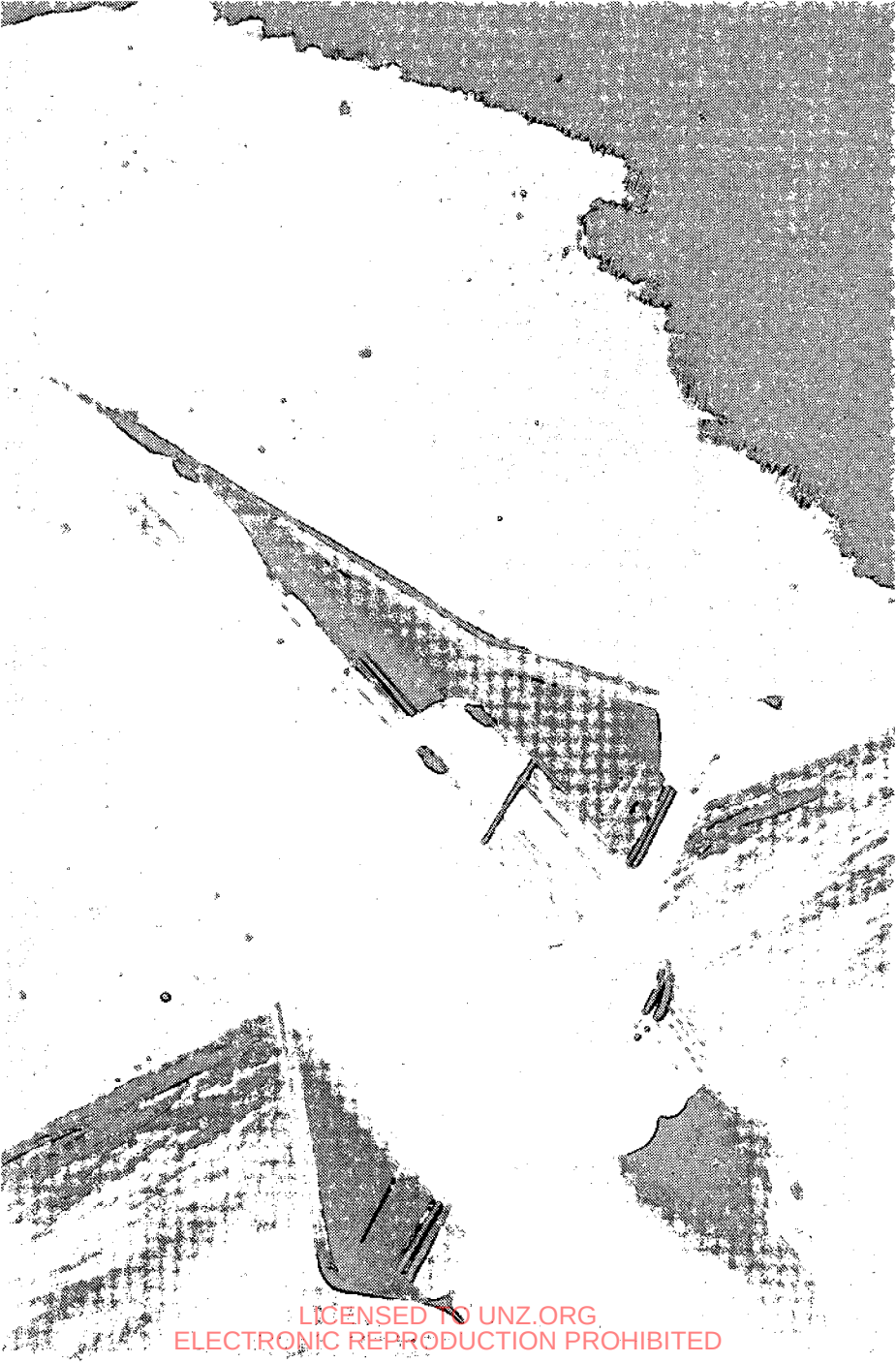

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This is a work of fiction.
More of it is real than you think!

Jake Knoll stared in the general direction of the fire, his eyes focused at a point in the darkness a hundred meters beyond the charred timbers, which were still spouting tendrils of flame.

"Shame about your boat," Fire Marshal Fredricks offered, indicating the blackened outline of a sleek, finned hull amidst the embers. "Would'a liked to see it go."

Jake continued to stare blankly for a few seconds, before the words sank in. "Boat . . . oh, yeah. Thanks," he replied dispiritedly, shrugging against the evening chill, and shifting his focus to the ruins of his project.

"Um, you covered by insurance?" the fire marshal asked.

Jake let out a long sigh. "Let it lapse a couple of months ago. Stupid, I know. Needed the money to finish the hull."

The fire marshal looked strangely relieved. "There's a sunny side to that, if you care to hear it."

"You mean because it's arson?" Jake asked.

Fredricks raised an eyebrow. "How'd you know?"

Jake shrugged. "Strong smell of kerosene. Pattern of blackened puddles around the barn. Spread fast. Building was engulfed before my alarm went off. Doesn't take a rocket scientist." He managed a thin smile at his little joke.

Fredricks nodded. "Do me a favor, stick to building boats. You make my job look too easy. But, I'm glad to say, at least this puts you way down on the list of suspects. Any idea who'd want to do something like this?"

"Yeah," Knoll replied, shifting his gaze to the left, toward a shallow lake at one corner of his property. "Told Johannson I'd be conductin' tests on the lake, and it would be too dangerous for him to water his cattle there for a few months. He said somethin' nasty. Guess I warn't exactly cordial neither. I told him he'd be trespassing if he let his critters on my land again, and I'd have him slapped with papers. He stomped off swearin' revenge."

The fire marshal gave him a quizzical glance. "You couldn't let him water his cattle while you were testing your boat?"

Jake shook his head. "It ain't . . . warn't . . . some fishing skiff, you know. I needed to test the engine. The tests would'a been a little dangerous, and even if they wasn't, the noise would'a terrified his cows."

Fredricks nodded understandingly. "Sure would'a liked to see it go."

Back at the house, Knoll slumped into the recliner, aware for the first time that his clothes reeked of wood smoke and burned plastic. He was working up the will to get up and take a shower when the phone rang.

"Jake, it's Baker Bret," said the voice on the other end. "Just got your call. What happened?"

"We're ruined," Jake answered. "Wiped out. Finished. Barn is burned to the ground, workshop's a total loss, nothing left of the lab but a concrete pad. Got my computers, my library, my notes, my drawings, everything."

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"The ship?"

"Nothing left but a big, crispy shell."

"Jeezus."

"Exactly."

"Guess we just have to start over."

Jake sighed deeply. "Listen careful, Bret, I said we're finished. Out of business. Broke. No capital. Nothing to start over with. We're out of the rocket business. Kaput. *Capish?*"

"Oh."

"I gotta get this stink off of me," Jake said impatiently. "If you don't mind, we can argue about pointless foolishness later, after I've had a good night's sleep."

Jake didn't sleep though, and the following morning he began rebuilding his project. He pulled a venerable Commodore 64 home computer from the closet, and simply started over. By the end of the week, he had funds committed to an escrow account by a customer who needed a cheaper alternative for lofting small payloads to Low Earth Orbit, and had a new consulting job to generate a little ready cash.

I get to tell this story from my perspective because Jake can't spell worth spit, and he flits from one idea to another so fast no reader can follow him. I was there, and I saw it happen, but I was really only a minor player. Jake and his Loyal Techs should get all the blame, and the accompanying glory.

I first met Dr. Jacob Knoll about a year after the fire. He had sent a letter commenting on a story I had written, and we had struck up a long correspondence. In the interim, I had started my own consulting service (consumer product safety and industrial troubleshooting, with space technology and nuclear research on the side). I'd offered to help Jake any way I could, realizing there was no money in it.

Through our correspondence, I'd learned, in detail, how Jake intended to build a single-stage-to-orbit, or SSTO, rocket in his barn, on a shoestring budget. It would take off and land on a runway like a plane, and was intended to be so cheap to build and operate it made the Delta Clipper look like a Golden Fleece. It sounded like a nutty idea at first, but he gradually won me over.

Nephew David, and David's wife Patti, moved in after the fire to help with the rebuilding. David was a physicist, and Patti was a chemist, both victims of federal rifs. Four additional Loyal Techs, including "Baker Bret," "Barefoot Jim," and "Star Spangled Sam," worked on various technical problems via the Internet. Loyal tech Dr. Gore was lined up to pilot the prototype, and was doing a little fusion research on the side. Nobody was getting paid a dime. The project was being funded by an assortment of consulting jobs and invention royalties, with a government subsidy for not growing crops helping to pay the taxes on the land, a generations-old working farm Jake had inherited.

I could describe the prototype spacecraft to you in detail, but perhaps you would do better to visit the Smithsonian's Air and Space Museum. There is a pretty close approximation

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of it hanging from the ceiling near the Apollo/Soyuz display. Once you've seen one high velocity lifting body you pretty much get the idea. The sleek, tapered fuselage was wider than high and provided the aerodynamic lift. A pair of winglets produced a modicum of steering while landing. Jake named the original prototype *Dervish*. That's *Whirling Dervish,* as in orbiting, sensible when you understand how Jake names things. The prototype lost in the fire was a little larger than the one at the Smithsonian. Had to be. *Dervish* was a four-seater.

Built of a foam core coated with high-performance composites and ceramics, *Dervish*'s aeroshell was feather-light, yet incredibly strong. I've worked with several rocket outfits, and seen plenty of designs, and it was unlike any spacecraft design I had ever seen. The usual designs involve complex aluminum frameworks, with stainless steel, inconel, and titanium used abundantly, a little graphite composite, and a tremendous amount of labor and money. The designers are quite proud of how light their birds are, but they are like lead bricks compared to Knoll's ship. *Dervish*'s construction was, in fact, closer to some experimental home-built aircraft designs.

Jake had always been very mysterious about the engines, for which he had some pretty fantastic expectations. Since my visit was to assist in a series of test burns, I was itching to get the chance to eyeball them firsthand.

I managed to piggy-back my first visit onto a business trip to Seattle. The money-making part of my trip over, I rented a Cessna 182 and headed east through the Cascades to visit Jake. Hauling my modest equipment was well within the capabilities of the tatty old workhorse. The town had a decent airport, not too much grass growing through the cracks in the runway, and plenty long enough to suit my rental bird. I pulled up to the FBO shack, and climbed out as a tall, gangly, gray-haired scarecrow of a man approached the plane.

"Tom?" he asked expectantly, offering a hand.

"Dr. Knoll?" I returned the question, naïvely inserting my hand into the pair of vice-grips disguised as human appendages he wore on his arms. I'd never seen his picture, but he had told me he looked like Ichabod Crane, only taller. This fellow fit the description.

"Limo's waiting," he said, grabbing a trunkful of my gear. I flexed my fingers to ease the pain, picked up my suitcase and briefcase, and followed him to a rusty early-sixties pickup truck, where he pushed various cans and boxes aside and laid my trunk gently in the bed. We finished loading and hopped in.

I habitually reached for my seat belt. Just as it occurred to me a truck this old wouldn't have one, my fingers closed on nylon webbing. I pulled, and found the vehicle was equipped with seat belt/shoulder harnesses, in good shape. I was about to tell Jake I thought that kind of safety-mindedness was a Good Sign in the rocket business, when he nodded my way.

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"'Bout to recommend that," he said. "Door has a bad habit of popping open." The starter clicked and whirred a few times, then caught, and we were on our way.

The short drive from the airport to his farm left little time for conversation, which mostly hinged on how to keep the battered door closed. We rattled to a stop by a newly built outbuilding, one of those soulless all-metal farm buildings that can never adequately substitute for hand-hewn timbers with mortise and tenon joints. If you looked closely, bits of charcoal were visible in the soil.

"Whatever happened with your neighbor?" I asked.

He huffed. "Bank heard he was under suspicion and figured he would probably be sued. They foreclosed on him, which he evidently had comin', figuring he would otherwise declare bankruptcy. Some kinda prior claim rule means I couldn't get nothing if I tried."

"He go to jail?"

"Nah, insufficient evidence, but at least he left the state. Funny thing though, turns out he actually did me something of a favor."

I looked at him quizzically as he hopped out of the truck and trotted eagerly to the door, moving like a teenager. "Come on, take a look at *Dervish Also*."

I rolled my eyes. What did I expect, something conventional like *Dervish II*? This was Jake Knoll. I got out of the truck and followed him into the barn. There, propped up at odd angles by sawhorses and dimension lumber, was the new aeroshell. The polyurethane foam shape was completed, and the surface was perhaps half coated with composites. The building reeked of plastic resins, and I knew I'd have a headache if I stayed there long. I knew roughly what to expect from his sketches, but the thing was impressive nonetheless. Jake had given me the dimensions, but I hadn't really pictured the size of it. It was designed to just fit in a standard semi truck trailer, if placed on edge.

"So what was the favor?" I asked.

"Out back, the old shell," he said, as if that explained anything. I followed him through the back door. Emerging back into the sunlight, I was distracted by a the sound of a tractor motor accompanied by a loud whirring, coming from a mound of earth and shed several hundred yards out in a field. "We'll see that next," he said, motioning me to a lean-to that sheltered what was left of the original hull. He gestured toward a broken apart section near the nose.

Approaching the charred blackened ruin, I could make out the slightly grayer charred paint of the name. "I see the problem. *D-I-R-VI-S-H*."

"Now, Tom," he said with a wink, "I believe I *told* you I can't spell worth spit. But that ain't the fatal flaw I had in mind. Check that broken area."

I bent to examine it. "Linear seams and voids in the foam," I commented. "Damned near full thickness at this point. Since this section is in aerodynamic compression, chances are it would have buckled inward."

"Hated to lose that old barn," Jake said, nodding. "Not nearly as much as I would have hated to lose a pilot and

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ship. Figured a way to inspect for it on the new ship. T-waves."

"Terahertz imaging? I'm impressed!" I was. That was cutting-edge technology, on the boundary between infrared and microwave, a region where quantum mechanics just starts to infringe on radio electronics, and the distinction between photons and electromagnetic waves begins to blur. I knew he didn't have the funds to *buy* the equipment, which meant he'd built it from scratch.

We trotted out to the building that had been producing the interesting noise, now reduced to a gentle slowing whine. I saw a young woman standing outside wearing chemical protective gear. The noise was coming from the mound, which was actually a large circular pit with the excess earth piled around it and a contraption situated in the center. The apparatus spinning down consisted of a large wooden wagon-wheelish looking thing attached to a vertically-mounted automobile differential rear axle. The other end of the axle was imbedded in a large concrete base, and the drive-shaft coupling had a large pulley that looked suspiciously like a wheel rim. The belt from the pulley led, through a long trench and a series of guide pulleys, to the shed, where it looped around another pulley attached to the power take-off of an old gray and red Ford tractor. I think *every* farm has one of those old tractors. Must be a law or something.

"Centrifuge?" I asked, noticing the evenly-spaced containers attached to the wheel.

Jake nodded. "Patti's whipping us up a batch of secret rocket propellant. 'Bout ready, Patti?"

"Be down in fifteen minutes," she shouted back.

"Secret?" I looked at Jake, who had a mischievous grin. "Mike Moscoe blew your secret oxidizer with 'Touch A Star,' a couple of years ago. Come to think of it, I seem to recall a rocket fuel mix the Three Stooges whipped up that included it."

We trotted back to the barn. David came down from the house to meet us, then we started gathering gear for the test burns. My apparatus, plus a test frame and the rocket motor, were loaded on an old flat-bed hay trailer, which smelled faintly of cow manure. Patti rounded the corner riding the old tractor, which she deftly backed up to the trailer. Jake had the two coupled in ten seconds.

I looked over the tractor, which bristled with added-on brackets and other home-made hardware. "My uncle had one of these. I guess 80 percent that were ever built must still be in use."

Jake scratched his head. "Eighty percent, well, maybe it's that low. George here is sort of a member of the family. He helped *raise* me. I remember when dad bought him from Three-Finger Tony. George is our loyalist tech."

We bounced down the dirt road to the test stand beside the little lake, led by David, driving the pickup hauling several flavors of rocket fuel in small cans, and trailed at a respectful distance by Patti hauling a small, well-cushioned tank of her freshly brewed concoction on a small rack installed

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on the back of an old Lincoln that could only get into first gear. I'd guessed that the stuff was highly concentrated hydrogen peroxide, a notoriously touchy compound. No doubt they used the Lincoln because it stood a better than even chance of surviving should the peroxide suddenly decide to revert to atomic oxygen and water. That effect, by itself, was a pretty good rocket fuel, and reason enough to carry it on a vehicle with a ride as smooth as a river barge.

David and Patti parked well away from the test stand, out of sight behind an earthen wall, where I had seen several well-separated bunkers. Jake and I pulled up to the stand and began unloading equipment. Jake moved in a continual trot, usually in a slight crouch, as if prepared to spring in any direction in an instant, and I think I would have been worn out just watching him. I came to realize this was his normal pace of work, which helped greatly to explain how he had accomplished so much in so short a time.

The first step in my equipment setup was for me to replace the old-fashioned spring-scale force-measuring kludge with an electronic load cell I'd picked up surplus. It fit nicely with the help of a battery-powered drill and a box of bits I'm never without. Then we mounted the rocket motor, a remarkably compact contraption wrapped with a tangle of wires and tubing.

"Ceramic?" I looked up quizzically when I noticed the material the engine casing was made of. "I presume there are some reinforcing fibers in it."

He smirked. "Just you mind your own business and hook up them wires."

"How do you cool it?" I asked, remembering a study of the Space Shuttle Main Engines I'd reviewed. NASA had been working on a nearly pure copper nozzle liner cooled by liquid hydrogen.

"MHD and thermal emissivity," he replied cryptically. "Hurry up, I want to run about a dozen tests this afternoon."

I installed ten thermocouples in wells he had provided in the motor casing and nozzle, found a spot on the concrete pad to mount a radiometer calibrated to act as a radiant energy thermometer so I could measure exhaust plume temperature, and ran the wires and cables back through a trench to a bank of well-shielded signal conditioners, and from there back to the control bunker, where I set up my computer. I also set up three video cameras, one normal, one infrared, and a special ultraviolet unit I had developed myself using some tricks from a NASA technical brief. These were tied to the computer, overlaying the images with synchronized time and data. I installed filters on the infrared and visible camera lenses to protect them from the intense light Jake expected, then calibrated the system, checked all the channels for function, and was ready to go.

First Patti, then David, came from their respective bunkers carrying small tanks of rocket juice. "You indicated you were going to use a tripropellant," I noted. "What combination are you using?"

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"Ah-well, that thar would hafta be a secret," Jake said with a mysterious grin. "Call this mix Wallbanger."

I rolled my eyes. "OK, be that way. Let me guess. I know you use hydrogen peroxide, I'd guess about 95 percent concentration, as an oxidizer."

"Well, let's just say it ain't the stuff that comes from Clairol," he replied with a confirming grin. "Course, that don't mean I won't also be trying liquid ozone."

"Yeah, right," I said recognizing a quickly dismissed possibility we had discussed in our letters, and retaliated with an even scarier possibility he'd suggested. "Or maybe tri-fluorine."

"Or di-lithium," he replied.

"Naming it after a drink probably means you've got some alcohol in it."

He shrugged. "Could just mean you'd only dream up this mix with a couple of stiff drinks in you."

I patted my equipment. "I'll have a pretty good idea of the third component when I see the color of the exhaust, anywhere from near infrared up through ultraviolet B and then some."

Patti and David scanned the area for unexpected visitors, then scurried back behind the earthworks to the control bunker. Jake primed the system and ran down a simple checklist, all remarkably informal to someone used to elaborate NASA test rituals. It was more like a mechanic planning to start a rebuilt gas engine.

I started the computer and video recordings, and he flipped the "fire" switch. At first, the little bunker sounded like the Concorde was parked just outside doing a run-up check with full afterburners, but the sound quickly changed to a piercing shriek.

"Damn," I said as he switched the thing off about three seconds later, "I'll need to zoom back for the next test. Exhaust plume went *way* off screen." I glanced at the computer screen. "And the radiometer went off scale. Hell, I had that thing set for eight thousand degrees Kelvin, the hottest rocket exhaust I've ever *heard* of."

"Well, now that's what comes of conventional thinking," Jake said with a self-satisfied grin. "Don't worry, that was just a little blip. We can run it again. Can you get an estimate of exhaust temperature from the UV video?"

"Yeah." I rewound the tape. "I'll reset the radiometer range higher on the next test. I've measured plasma spray temperatures over twenty thousand, but nothing that high from a purely chemical reaction."

Jake shook his head. "There's that conventional thinking again. What sort of nozzle temperatures did you get?"

I stared at the display. "Crap, the thermocouples must have slipped out. The hottest is only 148 degrees."

He nodded. "Sounds about right."

I stopped the tape and pressed play, then turned to stare at him. "How the hell do you keep it so cool? A laminar flow boundary layer?"

He shrugged. "MHD and Thermal Emissivity. What's the tape show?"

One side of the screen had a computer-generated color-temperature scale corresponding to the false-color images made by the camera. I shook

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my head. "Man, the calibration *has* to be off. I'm getting around 12,000 degrees."

Jake whooped and jumped in the air, then came down, slapped his thighs, and did a little dance. "Right on target," he sang, then he froze, looking at me like a kid at Christmas about to get a package from a rich relative. "What kind of thrust did it make?"

I read the figures, and he punched them into a calculator. "Bull's-eye," he rejoiced. "Tom, if you want specific impulse, you gotta have exhaust velocity. If you want exhaust velocity, you gotta have pressure. If you want pressure, you gotta have temperature."

I nodded, tolerating the lesson in basic thermodynamics. "But temperature is limited by available materials," I observed. "You have to have a way to *hold* the reaction. You told me you were trying to build a ship that could be turned around in half a day. Gas it and fly again. You need a conservative design that won't eat itself alive every time it runs."

Jake smiled patronizingly. "You've been looking at too many old chemical rocket engine designs, m'boy," he said. "And not enough at nuclear designs. Come on, put another quarter in that video game and let's do it again."

The second run with Wallbanger went flawlessly, a full thirty seconds, then we switched to a fuel system called "Meringue." Jake was a little disappointed with it, as it produced about 12 percent less umph than he had expected, but said the name came from the mixture being exceedingly touchy, and figured that had something to do with it. "Popcorn" worked satisfactorily, but the performance was lower than the others, as expected. Then we tried "Baked Beans," also an unimpressive performer which, I gather, used some hydrogen sulfide to try to boost reaction rate. "Cream Puff" was even better than Wallbanger.

I asked him where he got his fuel system names, and he admitted his loyal techs dreamed up most of them. I suggested that his loyal techs were probably underfed.

"Now," Jake announced with a flourish as Patti scurried back into the bunker after depositing her empty fuel canister, "we will try my favorite . . . Pan Galactic Gargleblaster, nothing less than the most potent rocket fuel ever designed by humankind. Everybody ready?" We nodded. "Drum roll." David drummed his pencils on the bench. "Lift-off!" He pressed the ignitor button.

The ground shook, there was a terrific bang, and the engine simply disappeared from my monitors, followed by what looked like a little rain squall with a bit of fog.

There was a moment of silence as we stared in disbelief at the monitors.

"What the hell happened?" I asked at last.

"You tell me," Jake replied. "What's the computer say?"

"The computer says all channels open-circuited about seven hundred microseconds after the main propellant valves opened." I rewound the normal video and stepped through the ignition sequence frame by frame.

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In one frame the engine was there, in the next it wasn't, just a handful of cables and thermocouple wire exiting stage left, and a few pieces of angle-iron support structure vibrating at odd angles.

Patti opened a locker and extracted four disposable hazmat suits plus four pairs of heavy rubber galoshes and gloves. David opened a couple of packages of chemical detector strips, and clothespinned them on the end of a long bamboo pole. Jake reached into the back of the locker and pulled out a three-lobed plastic boomerang.

David frowned. "You're not actually going to *try* that cockeyed idea, are you?"

Jake grinned. "Hell, everybody *knows* I'm a crazy rocket scientist. I'll try *anything*. Where's the tape?" He proceeded to tape a couple of detector strips to the boomerang, then opened the bunker door.

David led the way as we headed outside. We cautiously rounded the earthworks, waving the pole ahead of us and checking the indications of the test strips frequently. As soon as he had a clear shot at the test stand, Jake hauled his arm back and let loose with the boomerang, which sailed over the stand, arched up, and returned neatly a few yards away.

"There, see," Jake inspected the strips and showed them to each of us, "not a trace. It works."

David shook his head. "If I ever see a *positive* indication from that silly thing, I'll believe it. I *still* don't think it stays in the area long enough." He resumed his slow advance with the pole.

Jake winked at me. "He ain't never got a positive indication from the pole, neither," he whispered.

The front half of the rocket motor had evidently torn loose from the mounts, propelling itself, the valves, the control system, the small propellant tanks, and my load cell into a strategically located arrangement of sand and plastic trash cans filled with water. The fuel left in the tanks was consumed when they burst on impact. The crater was impressive.

"Well," Jake said as he fished the remains of the motor from the far end of the wreckage with a loop of cord he had rigged on the end of the bamboo pole, "rocket fuel is kinda like a chain saw. If it warn't dangerous, it wouldn't be very useful."

Patti and I picked up a few shards of nozzle, which were all we could find of the rest of the motor. We secured the site, tossed the components into buckets of water to remove any traces of propellant, and drove in silence back to the barn.

Gathered around a battered but solid old oak table, I pointed to the wire imbedded in the nozzle fragments. "MHD, you kept saying—magnetohydrodynamics, I kept thinking. You're using the rocket thrust to develop considerable amounts of electrical power, if I am not mistaken."

Jake nodded sullenly. "Something like that."

"Electric power for *what?*" I demanded. "Thermal Emissivity, whatever that means?" I eyed the rest of the motor fragments, from which dangled a profusion of wire and electrical gizmos.

"Electric fields," Jake said cryptical-

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ly. "Just leave it at that. I don't want to give any more away."

I considered the evidence for a moment, and things began to connect. I nodded. The thing *was* like some designs I had seen for thermonuclear propulsion systems that had yet to be built, yet it was clearly fueled by conventional chemistry. Or was it? Whatever his secret, clearly this engine was decades ahead of the engines being used to put anything else into space. The Shuttle main engines had some interesting turbo pumps and cooling systems, but were otherwise little different from those of the V2. Most other launch systems were merely refinements of engines developed in the '50s or '60s. Pegasus used solid rockets, the DC-X and Black Horse used Pratt and Whitney RL-10 engines from the Centaur, the X-34 would probably use Rocketdyne MA-5 engines from the Atlas, last I heard Conestoga was also using old engines, and the Air Force was launching most of its stuff on old Titans.

"Sorry about your equipment," Jake said mournfully, indicating the load cell, about five centimeters shorter now than when I had installed it.

I shrugged. "Two hundred bucks on the surplus market. It wasn't one of my good ones. It's a tax write-off, like renting the plane. Make it up to me by getting to orbit, so I can brag I helped. However, if you don't mind, I'll just give you the address of the surplus outfit, and *you* buy and keep the replacement."

"Fair enough," Jake agreed. "How about the radiometer?"

"Looks like it survived untouched, although the cable was severed in three places. I'll need to replace the cover window, but it's cheap. The thermocouples are expendable anyway, of course."

Jake shook his head as he looked at the shattered motor. "Who the hell do I think I'm kidding, tackling something like this, anyway?"

"The actual engine will have a forty to fifty centimeter nozzle, I think you said," I pointed out. "This was your ten-centimeter prototype, right?"

"Yeah."

"Didn't you read the piece by G. Harry Stine where he said something to the effect of you *have* to blow up the prototype, or you don't *learn* anything?"

His face brightened for the first time in an hour. "Yeah." Then he scowled again. "What exactly did I learn?"

I shrugged. "To take it easy the next time you try Pan Galactic Gargleblaster."

"Right," he nodded. "Any chance you'll be out this way again?"

"My customer in Seattle asked me to perform the same test for them in about a month. You take a crack at figuring out what went wrong, and let me know if you need any additional data taken, and we'll try this again."

We shook on it. By the time I took off for Seattle the following morning, the swelling in my hand was almost gone.

One of my customers back home in Virginia builds small satellites. My usual work for them is far more mundane than what I was doing for Jake, just

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proof-loading satellite handling fixtures, but it was enough to let me know the size and shape of their machines. They were well within the expected launch capacity of Jake's proposed second-generation workhorse design. They had been paying something like $15,000 per kilogram to get the things launched, compared to the $600 or less per kilogram Jake expected to charge, so I agreed to approach them to see if they were interested in backing the project.

I showed their project director photocopies of some of the sketches and data Jake had sent me over the years, with projected costs and performance. Perhaps that was a mistake. In the space business, a lot of people don't take you seriously if you don't have money for slick four-color brochures.

"Just sketches? Not very far along, is he?" the project director said with a disdainful sniff.

"He's nearing completion on his prototype aeroshell," I pointed out, "and is running engine test burns. Compare that to those guys up in Vancouver who just offered a prospectus for a new launch service based on preliminary drawings alone, but who have yet to even decide on an engine design or a fuel system. Or the folks down the road who just announced their new rocket. Lots of slick brochures and art, but they don't yet know if the engine will be parts from the Atlas or Russian Truds."

"Looks like a rank amateur to me."

"I watched that 'rank amateur' get 580 seconds of specific impulse on a test burn last week," I replied.

His eyebrows went up. "Jeezus, what is he burning?"

"He is reluctant to say. I can tell you it is a tripropellant, with an extremely sophisticated engine design."

"He's feeding you a line of crap," the project director retorted. "Specific impulse of over 460 seconds just won't work."

"Used my load cell and data acquisition system, so I know the calibration was kosher," I said, reaching into my briefcase for a copy of *The Starflight Handbook* and opening it to a page I had marked. "And if you'll notice, liquid ozone with liquid hydrogen is known to give specific impulse of over six hundred seconds." He looked at me with alarm. "Though that's not the oxidizer he uses," I added.

He flipped the book over to look at the title on the cover, and snorted. Evidently he was not familiar with it. "He's building a damned bomb. What in hell makes him think he *needs* that kind of performance?"

"The technology Dr. Knoll is building is horizontal takeoff, horizontal landing, SSTO, fully reusable, quick turnaround, with a very high payload fraction."

He laughed. "Another for-sure crackpot crazy amateur rocket scientist! He can't *possibly* have any idea of what it costs to get into space if he thinks it can be done for six hundred bucks a kilo. Yeah, it's possible to build an SSTO. You can use the hottest stuff you can find and the engine will blow up on half your launches, or you can lighten the structure until it breaks up on the pad, and you *still* won't get a decent payload frac-

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tion. It has been conclusively demonstrated that the best SSTO design has two stages."

"So you're saying you won't even take a serious look at a technology that might cost a twentieth or less of what you are paying for launch services now?"

He shrugged. "In the first place, launch services don't cost *me* anything. The government pays to launch these satellites. What costs *me* is if the damned rocket blows up and Congress decides to cancel the program. I'm not ready to try any unproven launch system with a cockeyed new engine that hasn't been used successfully at least ten times, and preferably more like a hundred. In the second place, I don't buy from amateurs. Call me after you've launched our competitors' satellites a dozen times."

That was the end of the meeting.

I stewed all the way back to my lab. I realized I was being irrational by taking the rejection personally. After all, I was just a contractor, a peripheral figure, in the project. In fact, not only was I not making a dime on it so far, it was *costing* me money. Any reasonable view of new businesses in general, and space businesses in particular, would show 90 percent or more odds the venture would fall flat on its ass, with no skin off *my* back. And the project director was right, the project *was* amateurish, underfunded, and an order of magnitude or two below everybody else's assessment of the problem.

Back home, I checked the mail, and found a copy of *Flying* magazine amidst the bills and junk mail. On the cover was a Lancair, a sporty composite kit-plane that had just won another cross-country race. The close runner-up, another sleek composite kit-plane, was flying formation with it. Third place, a half-million dollar, three hundred horsepower, twenty gallon per hour, commercially-built aluminum machine whose ancestor had first flown in 1947, had tagged along half an hour later, about sixty knots slower. Honorable mention went to another kit-plane that had been right behind number three, propelled by an eighty horsepower engine burning less than four gallons an hour.

I stared at the Lancair, whose graceful lines had taken shape in a garage or hangar somewhere. Not only was this plane home-built from a kit, its design was a refinement of a plane that had started from a clean sheet of paper, the dream of a knowledgeable "amateur" who had rejected the ancient designs offered by "professional" aircraft companies, and opted instead for higher performance at lower cost, using modern materials and aerodynamic theories.

From somewhere out of the back of my mind rolled a television exposé of a small remote-piloted aircraft designed for battlefield recon, the prototype for which was built by a couple of amateur model aircraft enthusiasts for a few thousand dollars. The project had been usurped by a large corporation, who spent tens of millions developing a high-tech version that didn't work as well.

Then, of course, there were the other amateurs, like Wilbur and Orville Wright, Robert Goddard,

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Werner Von Braun. . . . Oh, just go through any good aerospace history book, and you'll see bunches of good examples.

That was what had me so offended, I realized. My personal stake in this was a system that wasn't ready to take a serious look at revolutionary new technologies, particularly if they were developed by amateurs, i.e. *amatori,* i.e. people who do what they do because they *love* it. My stake was also that access to space, and its incalculable bounty, was hog-tied by the enormous cost of getting into orbit. Even if Jake Knoll failed, his concepts were sound, and his results were promising. He, or someone else, could try again. When they finally succeeded, the payoff would be *enormous.*

And that gave me an appreciation of *other* amateurs: people like aviation pioneers Otto Lilienthal and Percy Pilcher, and the countless nameless others who had tried and failed. Their names are in the same good aviation history books. Others learned from their mistakes and succeeded.

The follow-up tests, on a new engine with connections to allow me to monitor the mysterious "electric fields," worked well. We uncovered the probable cause of the previous explosion, came up with a tune-up protocol that avoided it, did a number of full-power runs using Pan Galactic Gargleblaster, and got a specific impulse a smidge over 600 seconds. Then we did what G. Harry Stine said we must, we blew it up. Quite deliberately, we duplicated the conditions of the previous test, and turned the engine into smithereens, just to be sure we understood the problem. This time, we removed the expensive instrumentation first.

Shortly thereafter, Jake got lucky at an auction of damaged aircraft. The sale featured some cherries that got all the attention, and Jake drove away with the remains of a Learjet for $500. The plane had been involved in a fire during maintenance, which had burned the back half of it to unidentifiable junk, and took out the hangar in the process. The cockpit was intact, although it was an older model, and its maintenance logs were lost in the fire. Without a paper trail, the plane was essentially permanently unairworthy. Awash in better prospects, none of the other bidders bothered to look at it, even for parts, suspecting the ancient thing was equipped with junk. In fact, it had some very nice modern instruments and radios. Jake made his $500 back selling the nose landing gear to a South American parts depot, and equipped the cockpit of *Dervish* for free.

Some months later, I returned to witness glide tests of the aeroshell. The FAA had little problem with Jake's request to do the unpowered tests under existing Experimental Class rules, especially with Dr. Gore, a qualified test pilot, at the controls. Of course, nobody said anything about eventual installation of rocket engines to them in the application. Jake sweet-talked a friend of his into towing *Dervish* behind a DC-3 cropduster that turned out to still have the original towing hardware it had used to pull a pair of

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Waco gliders to Normandy on June 6, 1944. I got to fly as unofficial co-pilot of the old warbird, though I spent most of the time operating a video camera. We conducted the tests in Nevada, away from the curious eyes of neighbors, especially Fire Marshal Fredricks, who was still under the impression Jake was building a jet-powered speedboat.

I was impressed with Dr. (Captain) Chuck Gore. He'd flown F-4s in Viet Nam, in a flight that included Lt. Blood, Lt. Goetz, and Major Coffin. Sort of the four horsemen of the Apocalypse, burning JP-4.

Jake couldn't afford a series of ground tracking stations or access to NASA's TDRS data relay satellites, and was hoping to use cellular phones and modems to communicate with *Dervish* over the Internet. Barefoot Jim and I managed to quash that idea, which was mega-illegal. Together, we hatched a scheme to use the network of amateur radio "digipeaters" to track the ship. Ah, radio hams, I forgot to mention them. Yes, another bunch of true pioneers who were the original developers of a number of modern technologies, who also love what they do. No strangers to space technology, they have put up a series of amateur-built "Oscar" satellites, at very low cost and low weight. They were becoming excited over an idea of Jake's to build a 45 kilogram orbiting radio telescope to beat NASA at their own game, and were also keen on the idea of free launch services in exchange for the digipeater favor. They sweet-talked the FCC into acknowledging that since Jake was obviously an amateur, his ship qualified for an amateur radio station license. The Amateur Radio Relay League lined up a database of frequencies, access codes, and locations for digipeaters whose operators had volunteered, which was nearly every digipeater operator on the face of the Earth.

About this time, a friend of mine finished his all-wood, home-designed, home-built plane, the pride of fifteen years of loving work. I was prospering, and was able to buy his GlasAir, a composite home-built kit-plane he had put together when problems with the wooden design seemed insurmountable. I flew cross-country out to Washington to test the digipeater system, which worked with only a few, easily-remedied glitches. Jake studied my pride and joy intensely, declared it to be "OK for a start, but heavy as a brick. Soon as I have time, I think I'll show this business how to build these things."

Having proved *Dervish*'s basic airworthiness, Jake began installing life support and other systems. The term "off-the-shelf" has been applied to a number of "low-cost" space projects lately, with $150 *million* qualifying as cheap. Jake broke new frontiers in cheap, and deserves a new term. I propose "out-of-the-basement." Funding what he knew should be a million-and-a-half dollar project out-of-pocket, every scrounging and cost-cutting measure possible was needed. Besides the stuff from the trashed Lear, pieces came from surplus catalogs, scuba diving catalogs, solar home suppliers, camping suppliers, amateur radio "hamfest" tailgate sales, and a cou-

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ple of local yard sales. Kenton Thurman had a plumbing and hardware store down the road in Wenatchee, and had written in response to a story entitled "The Pattern," bragging about how his stores adapted to local needs. I called him on it. He found himself adding nickel tubing and aircraft-grade bolts to his inventory.

Testing the aeroshell and its systems in a vacuum was a tough nut to crack. Jake and his crew turned most of the inside of the barn into a huge test chamber by building a foam-cored composite vessel large enough to hold the craft. The test chamber was covered with cheaper automotive-grade fiberglass and polyester, and a slathering of concrete, but was otherwise similar in construction to the aeroshell. It sealed with silicone and bolts, the end cover dragged into position by George. The high-capacity vacuum pump was made from an old big-block V-8, turned by the power take-off of the old tractor. The chamber couldn't come anywhere near the vacuum of space, but it tracked down the leaks, revealed an outgassing problem with the foam that could be compensated for, and proved the systems would continue to function to at least one hundred thousand feet.

We moved the engine test site to Nevada for the tests of the big engine. The little one had drawn too much attention from Jake's neighbors. We had finally mounted the little engine on *Dervish,* which floated like a cork, and staged a demonstration on a large lake near town. Jake came up with a low-potency fuel mixture called "Molotov Cocktail," especially for the purpose. It produced plenty of flame and fury, to the delight of Fredricks and the other town-folk, but Jake deliberately kept the speed down. We learned *Dervish* was an *awful* race boat. In spite of the truck-load of sandbags we'd ballasted it with, it wanted to *fly.*

Then the problems started. No way was the FAA going to let us test a rocket plane. NASA just laughed and handed us a bunch of test requirements that would have cost a hundred million dollars to comply with. Jake tried the FAA again, proposing to put a jet engine on *Dervish* instead. No dice. We looked into moving to another country, but the cost was out of reach.

The project was technically well along at that point, but apparently up against a bureaucratic brick wall, the problems something I couldn't help with. I drifted off to other projects, though I kept up the correspondence. Jake wrote less and less frequently, and seemed more inclined to discuss starship designs than SSTO development. I feared he was losing heart, but understood. It had been a hell of a long shot from the start, and the final obstacles were predictable.

The phone rang late one Friday night. It was Jake. I clearly remember his exact words. "Tom, get your ass out here right *now,* or you'll wish you had." Further, he would not elaborate, except that I was needed, with gear, on Sunday morning.

I bought a ticket on a commercial jet. I hated to let somebody else do the flying, but I evidently needed to

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get there fast. I rented the same old Cessna in Seattle, and boogied through the mountains to Jake's farm. Jake met me at the airport again, this time trotting from a door in a hangar I had thought was abandoned.

He gave me a bear hug. "You made it! Let's go. Lots to do." I trotted to keep up as he headed back to the hangar at his usual pace. There, in the pale light from four brand-new explosion-resistant fluorescent fixtures, was *Dervish*. It seemed different somehow, almost . . . *alive*. Lights and soft noises emanated from it, and tangy and oily chemical scents filled the hangar. I noticed a patina of wear on its sleek skin.

I recognized Patti, David, and Dr. Gore. There were two strange faces. "Wired Tom," Jake announced, "meet Baker Bret and Star-Spangled Sam." Oooh, a nickname. I was actually a bona-fide Loyal Tech. I shook hands all around.

I gazed at *Dervish*. Dr. Gore was ducking, peering, and prodding all around it, a pre-flight inspection if ever I've seen one. "You're going to fly it! From *here?*"

Jake nodded.

"This legit?"

"Hell, no!"

I noticed the registration number N214PW painted on the fuselage. "The FAA approved it to fly?"

Jake led me to the crew hatch, above which was stenciled "EXPERIMENTAL SPACE ROCKET—DANGEROUS AS HELL." The aircraft dataplate from the Learjet was attached to the frame. "You've heard of outfits that build an airplane around a dataplate? That's basically what we've done. That's the tail number of the original Lear."

I shook my head. "That *can't* be legal."

Jake grinned. "Sure cuts down questions when you file a flight plan, though."

I shook my head. "Wait a minute, you've done this *before?*"

He nodded. "Flown it a buncha times down in Nevada. Found this little desert down in between the mountains that's all Class G airspace. Class Go For It, uncontrolled, no nosy radar coverage, no traffic except the occasional drug smuggler, nothing but miles and miles of sagebrush and pinion pines."

"Class G, OK, but that's low altitude. Speed limit of 250 knots, and it ends at 14,500 feet max, right?"

Dr. Gore joined in. "Right. Keep in mind, the area is so remote, controlled traffic stays much higher to maintain radar coverage and radio contact. With almost no traffic and no cops, well, let's just say nobody out there drives the double nickel, either. On occasion, we act like normal traffic and pop up a little higher. We've even filed in-flight IFR flight plans a couple of times and taken it up to 58,000 feet."

I frowned. "But you'd have to act like a Learjet, right?"

Gore nodded. "Right, but at least we got some flight time in on it, and a little altitude. Handles nice. Lands a little fast."

Jake slapped Dr. Gore on the back. "Sounds like another Yeager, don't he, Tom? Don't think Yeager ever *flew* a

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plane he didn't like, even the ones that scared everybody else spitless."

Dr. Gore blushed. "I'm no Yeager. I'm ready, though."

Jake's eyes twinkled. "We're going for it, Tom."

"Orbit?!!" My eyes must have about popped from their sockets.

"Lee-Oh, lee-hee-hee-oh," Jake sang. "Low Earth Orbit and then we come home."

"Be a little hard to hide that," I observed.

"Sure *hope* so," Jake said, the grin contorting his face like a Greek mask. "We'll take off out of here like private IFR traffic, fly south a little to get well clear of Canadian airspace while we clear the Cascades, then turn west and request clearance to flight level 600. Spot we picked rarely has any traffic, especially Sunday morning. If there is, we can abort, dump the fuel, land, and try again, though that would be bound to draw a crowd. If we get clearance, we point the ship almost straight up and pour on the Gargle-blaster. When we pass 60,000 feet, we're back in uncontrolled airspace, only need to maintain visual separation with the Aurora, and can give air traffic control the razz-berry."

"Now, let me see if I've got this straight," I argued. "You're taking off to the *west,* against Earth's rotation."

Jake shrugged. "Well, more to the *south*-west, actually. No problem. Light load, plenty of fuel. Be a *great* demonstration of what we can do. Besides, it puts us over water quicker, gives Vandenberg a real good look at us, and we don't pass over nobody with nukes until everybody knows what we're up to."

"Jake, they're gonna throw you in jail for sure."

He nodded. "Probably. But they'll pay attention."

After a late night, we rose early to finish launch preparations.

Most of the data acquisition would be handled over the Internet through a couple of old computers Jake had bought when I finally convinced him a Commodore wasn't a proper machine for rocket science; never mind he did most of the design with it. My computers weren't needed, but my video system and rental plane were. My job was to fly a chase plane mission.

"Like a 182 is going to keep up with a rocket," I quipped.

"You'll get a nice fly-by, and maybe even get the takeoff," Jake said. "And we'll try to work it out so you can track the main climb. Patti will go with you to work the camera. One way or another, we'll make the evening news. 'Film at six!'"

"You're in the Civil Air Patrol, right?" Dr. Gore asked.

"Yeah. So far. If this doesn't get me kicked out."

He pulled an emergency locator transmitter from a pocket on the right leg of his flight suit. "Can you track an ELT from the Cessna?"

I nodded. "No DF equipment, but I can do it with wing shadow method."

"Good. If something goes wrong I can bail out. If I'm still over land, get a fix on me, OK?"

"No problem."

The launch had been planned for

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Sunday morning because the good people of the surrounding farms and communities would be in church, and paying no mind to unusual aircraft showing up at the airport. We drove to the airport just after dawn to check the systems and fuel the ship, waited for everyone to get to church, and rolled *Dervish* out to the run-up pad, with the help of that faithful old tractor, George.

Dr. Gore climbed in, wearing a skintight home-made pressure suit with a helmet that looked a little like something you'd see in a movie from the '30's. His nomex flight suit was worn over the pressure suit. I took off in the Cessna to get into position, while the preparations continued, and checked in with Center, a local courtesy due to the nearby Canadian border. I suppose the best way to describe the launch is to give you what I recorded on the radio.

"Pasayten traffic, Lear 214 Papa Whiskey, taking the active on 16 for immediate takeoff."

"Pasayten traffic, Lear 4 Papa Whiskey, departing to the south."

"Lear 4 Papa Whiskey, Cessna 2 Golf Sierra, ten south at ten five has you in sight."

"Cessna 2 Golf Sierra, roger, no joy, beginning climb."

"Cessna 2 Golf Sierra, Lear 4 Papa Whiskey, tally-ho, commencing fly-by."

"Four Papa Whiskey, roger, 2 Golf Sierra has camera rolling."

"Pasayten traffic, Lear 4 Papa Whiskey leaving frequency for Center."

"Seattle Center, Lear 214 Papa Whiskey, over Loomis at ten five, opening flight plan."

"Lear 4 Papa Whiskey, Center, roger, squawk 1722."

"One-seven-two-two, roger, 4 Papa Whiskey."

"Lear 4 Papa Whiskey, radar contact over Loomis, approved on course as filed. Clear above, climb to flight level 600 at your discretion. Flight level 600??! Uh, what model Lear is that?"

"Oh, Lear 4 Papa Whiskey is a real special model, as you are about to see. I'd like to climb pretty quick. You sure it's clear above us?"

"Four Papa Whiskey, Center," the controller answered testily, *"nobody above you for two hundred miles in any direction. You could take off straight up if you wanted. You came awfully close to the Cessna traffic that departed ahead of you a few minutes back, though."*

"'S'OK, we coordinated it. Straight up? That sounds like fun. Think I will. Thanks, Center."

At that point, Gore opened the throttle and showed the controller just how special his little business jet was. Patti still had him clearly on the video. The previously invisible exhaust suddenly turned to a streak of flame like a welder's torch, but white-violet hot and a whole lot longer. *Dervish* pitched up and accelerated for the sky like, well, a rocket. In eighty seconds, it had passed its assigned altitude.

"Center, orbital rocket 214 Papa Whiskey is now clear of your airspace. Just go ahead and cancel that

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flight plan, will you? And after that, maybe you could call NORAD and let them know a crazy bunch of amateur rocket scientists has just launched a manned flight southwest from the Pacific Northwest for retrograde orbit. They should be hearing from us over the Internet about now, but they'll probably think it's a prank. I'll give Hawaii a buzz in about sixteen minutes, and be back with you in about an hour and a half."

I will not print the controller's reply, in the interest of his continued employment. We tracked *Dervish* until it was out of sight, then stayed on-station until there was no chance we could be of any assistance, which took only a few minutes. We returned to the airport.

The departure had been noisy. Not many young boys, or girls, for that matter, have enough self-discipline, even in church, not to run to a window when a shrieking rocket plane takes off from the local airport, nor are they likely to return to their pews when they notice the rocket is their favorite speedboat. By the time of the big climb, pretty much the whole valley was watching. We beat a hasty retreat back to the farm to track the data. Jake hid down in the cellar with his computer, tracking the flight, while we fended off the curious neighbors who were pouring down the driveway. We held nothing back. They were too dumbfounded to know if they were thrilled, angry, or terrified. Unfortunately, in the process, we couldn't keep track of the flight.

The reporters from the local newspaper and radio station arrived, and I got pushed into the role of impromptu Public Affairs Officer, explaining what had happened and making sure they had everyone's names spelled right. Patti scurried inside to make copies of our video, which we passed out to their considerable delight.

The commotion was building rapidly when Jake slipped out on the porch, his face ashen, and pulled me inside. "Tom, take David and get back out to the Cessna. We've got a problem."

"Jeezus," I said, struggling to keep my voice down. "What happened?"

"We reached apogee, 900 kilometers as planned, and the engine failed. No circularization burn. It's coming back down."

"Is he all right?"

Jake nodded. "So far. Since the flight profile started with a big climb, and was nice and high, he'll make a full orbit. We think just a wee bit more, in fact, thanks to aerodynamics. Course, his trajectory will be over the Pacific due to Earth's rotation, but he can do a reentry surfing maneuver to bring him back near here. He's going to try to land at Seattle. Best emergency facilities around, and he can ditch it in the water if it's a miss."

"Sounds like a good plan," I commented. "You want me to chase inbound in case something goes wrong, then?"

"Right. Here's the frequency he'll try to reach you on."

"How long will he be in radio blackout?" I asked, remembering the problems NASA had.

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"Shouldn't be a problem," Jake answered. "*Dervish* don't streak back like some burnt-up space junk, it *flies* back, light as a feather and cool as a cucumber. OK, maybe cool as a baked potato. I'll keep you updated, same frequency. You act as a relay if we need it."

I saluted, grabbed my flight kit, and was out the door.

Ten minutes later, we were airborne. I contacted Jake. "Any news from the Good Ship *Dervish*?"

"Seattle is fogged in. He'll try diverting to Spokane."

"Is that a problem?"

"Should be OK, unless something goes wrong. If it does, there's no water to ditch in."

"Roger that."

"Can you position yourself near Republic? He'll pass over there at around twenty, maybe thirty thousand feet."

"Wilco."

We flew toward the designated point, climbing to 12,000 feet, about as high as the Cessna or I was really comfortable. David scanned the sky, searching for *Dervish*, and wished we were in the bubble-canopied Glasair, instead of the high-winged 182.

"Doesn't matter so much if we see him pass over," I noted. "You probably wouldn't see something that small with no contrail at 30,000 feet anyway. If we're looking for him on the ground, this is a superior search plane."

Just then Dr. Gore's voice came over the radio. *"Cessna 2 Golf Sierra, this is 214 Papa Whiskey, over."*

"Four Papa Whiskey, 2 Golf Sierra copies, loud and clear, over."

"Got a problem here, fuel dump system isn't operating. Feels like maybe the cable has seized up. Spokane says we can't land, and I don't blame them."

"What's your alternate?" I asked, anxiously.

"No alternate, and since I've already diverted, I can't reach open water."

"What about a lake?" There were several fair-sized ones about.

"Too many boaters, especially on a Sunday. My best bet is to bail out and let it crash in the woods."

The thought horrified me. *Dervish* had no ejection system, just a hatch. "What about a dry lake bed?"

"Rained last Wednesday. I'd crack up in the mud. Same if I tried to land in the desert. This thing is like a Styrofoam cup full of rocket fuel, and it needs a smooth landing area. Gotta go now. I'm turning on my ELT. See you on the ground; 214 Papa Whiskey out."

"Four Papa Whiskey, 2 Golf Sierra, over?" I tried several times, with no response. "Mission base, 2 Golf Sierra, did you copy that?"

"We copied. Your ball, 2 Golf Sierra. Track him."

I habitually leave my second radio on 121.5, the aircraft emergency frequency, and just then I began to pick up a dew-dew-dew alarm signal from an ELT. "That's him, David. Sounds like he's not too far away. Hang on."

I put the plane in a steep left turn, noted the heading as the signal dropped out, and straightened out.

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"OK, David, we're over Havilah. Got it on the chart?"

"Got it."

"OK, now draw a line 135, no, make that 150 degrees from there."

"Like this?"

"Yeah. Go ahead and start scanning for him. You know the color of his parachute?"

David nodded, turning his attention to the sky. "It's a purple and gold balloot. Very distinctive."

I headed west the short distance to Ellisford to take another bearing for triangulation, and put the plane into another brisk turn. "OK, that's 175 degrees." I looked at the line David put on the chart. "Crap, something's wrong, they don't converge."

We took another bearing from the same point. This time we got two hundred and ten degrees. "Damn! That's a moving target. Westbound and fast. Jeezus, I hope he didn't get hung up trying to bail out."

"I think the signal is getting weaker," David observed.

"I think you're right. I'm taking us west. Keep your eyes peeled. He may have aimed it for the National Forest."

A few minutes later, the ELT signal disappeared suddenly, in mid-bleep. David pointed, open-mouthed. I saw it too. About fifty miles southwest of us, a large, orange fireball erupted from the side of a mountain.

We reached the site about fifteen minutes later, and circled over it in absolute silence. *Dervish* had hit on the rubble near the base of a small cliff on the east slope of a crescent-shaped mountain. Fragments of the lightweight aeroshell had been thrown from the shallow crater, and were readily identifiable. There was no sign of a chute.

"Two Golf Sierra, Mission Base, do you have him yet?"

"Mission Base, 2 Golf Sierra, *Dervish* is down, four eight degrees, ten minutes, niner seconds north; one two zero degrees, seventeen minutes, ten seconds west. The ELT was apparently with it."

There was an uneasy silence from the other end, then a subdued enquiry. *"Any sign of a survivor?"*

I tried to remember some of the polite ways of delivering bad news over an open radio channel. "Hair, teeth and eyeballs all over the place," is rough on any family members listening in. I'd heard a medical technician use "no vital signs" once, after a plane had hit sixty degrees nose-down at three hundred knots.

"Survival unlikely," I replied.

We touched down at the airport and pushed through the throng of reporters with no comment, taking David's car back to the farm. The scene was a zoo, but not as bad as it would be soon, when the caravan of satellite news trucks we had seen coming up highway 97 arrived. With some doing, we made it into the house, just in time to hear a loud pop. I jumped. Then I recognized sounds of glee amidst the turmoil.

Jake came to us with a couple of jelly glasses with a generous dose of some sort of bubbly amber liquid in each. "He's *alive!* Just got off the phone with him. Came down in a Walmart parking lot in Omak and called us from a pay phone. Collect, if

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you can imagine the nerve! He's hitching a ride to the airport just north of there. Think you can go pick him up?"

I looked dubiously at the glass of fizzy stuff, and started to put it down.

"Drink up! Carbonated apple juice was all we had."

I downed the concoction, which tasted pretty good. "But what about the ELT? How—"

"Almost forgot," Jake apologized, ducking momentarily into a bedroom. He emerged with a pair of jeans. "These ought to fit, if he rolls the legs up a mite. He lost the bottom half of his flight suit coming out the hatch. Says people are staring at his plastic union suit."

The next morning, we arrived bright and early at the crash site, via National Guard helicopter. The CAP had done a nice job of securing it against die-hard reporters who had hiked all night to reach it. NASA and the Pentagon had been vying for access, but, since *Dervish* was registered as a Learjet, the National Transportation Safety Board won out in the jurisdictional pissing contest. I recognized their representatives immediately.

"Jean, Joe, they got you out of the lab for this one, did they?"

They waved and started over. "Tom, how did you get mixed up in this?" Jean asked.

"Um, I'm just a consultant, honest." That was once, and I hadn't heard a rooster crow yet. I handed Joe a removable hard disk wrapped in antistatic blister pack. "Here's the flight data record. Dr. Gore put it in his vest pocket before bailing out. We'll need a copy of it, and I can help you decipher it when we get back to DC."

Jake looked at me. "You know these two?"

I shrugged. "Former co-worker and an old motorcycle riding buddy. Damned competent people. I'm glad to see them."

Joe turned to take in the surroundings. "He couldn't have picked a better spot if he had *tried*. Talus slope at the bottom of a cliff. Nobody for miles. Barely even damaged any trees."

"Hitting this spot was no accident," Jake said. "Well, maybe a little. See that big rock over there about thirty meters? That's what he set the autopilot for. It's his favorite sitting rock. He *knew* this was the best place to put it down—in fact, it was our take-off worst-case abort alternative."

Jean shivered, nodding toward the smashed remains of a Global Positioning System receiver. "Cruise *Dervish*. GPS-linked autopilots *scare* me."

I shrugged. "Lots of planes are equipped that way. Pretty soon, *most* will be. Nothing particularly sinister about *Dervish*."

Jean looked at me squarely. "Exactly."

There was little indication of dangerous chemicals, but we donned hazmat gear just to be sure. Jake's formula makes surprisingly non-toxic residue, and the reactants are so reactive there is unlikely to be much left after a blast. We picked our way into the crash site, identifying and photographing debris, until we came to the center of the shallow crater. The aeroshell had been reduced to hun-

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dreds of small pieces, but it was obvious that nothing had come off before impact. Jean and Joe found some smashed cockpit instruments, and noted an indicated airspeed of only 260 knots at impact.

Jake and I found the engine, barely damaged, exactly in the center of the crater.

"If *Dervish* went in nose-first, the fuel tanks would have ruptured, producing a soft explosion," I noted. "There'd be a pretty intense Leidenfrost layer between the tanks, and mixing zones as you get farther out on that plane, but most of the energy would be expended in a pretty diffused fireball. The engine was directly behind the tanks. Probably dropped the impact velocity considerably, sort of like an airbag going off."

Jake pointed to the various sheared-off connections. "I believe you're right. We're in luck. Probably learn a lot from this."

Two weeks later, Jake and I were sitting at his kitchen table, vacantly staring at a spread of photographs of burned and broken debris. On the counter were various newspapers and clippings, with headlines using words like "CRASH" and "FAILURE." There was a knock at the door.

Jake looked up. "It ain't locked. Come in."

A stately woman in a conservative business suit stepped in. "Dr. Knoll?"

He nodded, and slowly rose from his chair.

She offered a hand. He accepted it gently. "You haven't met me, but you have some of my money in an escrow account. I'm Clarissa Morton, Morton Launch Brokers."

Jake nodded again. "You'll be wanting your quarter million back, I reckon. I'll sign the papers."

"Not just yet," she said. "How's your pilot, Gore?"

"Feeling pretty glum, if you'll accept an understatement. Probably never fly again when the FAA gets through with him."

"Don't bet on it," she said, pulling a business card from her purse. "This guy's an aviation lawyer, and he's still pretty steamed with the FAA over the Hoover incident. He thinks he can get the penalty down to about a ninety-day suspension. He'll do it *pro bono*."

Jake raised an eyebrow as he took the card. "I sort'a figgered they'd throw the book at the bunch of us."

She shrugged. "They probably will, but the book didn't anticipate most of what you did." She glanced at the pile of newspapers. "I have a feeling this initial mess will blow over, and the press will start asking a different sort of question pretty soon." She stepped over to the table to look at the photos. "Figure out what went wrong yet?"

"Tell her what you found, Tom."

I picked up a photo of a small crushed box with several electrical connectors. "This is the engine control computer. See the little burned mark on the case? High voltage arc. Got in and zapped the computer."

"Do you know where it came from?" she asked.

Jake spoke up. "There's the rub. Came from the magnetohydrodynamic generator. Had a weakness in the electrical insulation that had never

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been detected before. Altitude related. In the atmosphere, air acts as an insulator. In rarefied atmospheres, or a vacuum, sometimes arcs can form that you wouldn't get otherwise. Could'a prevented this with a dab of silicone seal, if we'd known."

She pointed to a picture of a couple of cables, similar to lawn mower throttle cables. "Those the fuel dump cables that froze up?"

I nodded. "Vacuum welded."

Jake shook his head. "If we'd used Teflon-lined motorcycle cables, would'a worked perfectly. You know, we probably could'a landed just fine at any airport around, even with fuel aboard. Near as we can tell, everything else worked fine. What can I say? We tried. We failed. Where are those papers?"

"Aren't you going to try again?"

He looked at her. "Lady, I'm so flat broke I can't pay my light bill. I'm runnin' off the windmill out there."

"What would it cost to build another copy?"

"A million and a half."

She pulled out a check book and started writing. "Seriously. Ten million be enough?"

Jake dropped back in his chair like a sack of coarse cracked corn. "Wha?"

"Dr. Knoll, I'm tired of waiting for you to build this thing," she said. "I was about ready to ask for my money back. You've been making silly excuses about your barn burning down, red tape, how you were saving money by doing it all yourself and on the cheap." She tore off the check and handed it to him. "No more excuses. Hire some people, buy some parts, and get *on* with it."

Jake stared at the slip of paper in disbelief. "Sorry. Counting the zeros. Be easier if you just used scientific notation. Damn, you're *serious*."

"Quite. I suggest you knock off another quick copy of *Dervish,* and, at the same time, get started on the full-sized model. Pretty obvious you're on the right track, and know what you're doing." She reached in her purse and pulled out a twenty-dollar bill. "And here, a tube of silicone seal and some motorcycle cables, on me."

I came around the table to ogle all the zeros on the check. "That's a lot of money," was the cleverest thing I could think of to say.

"That's chump change in the rocket business," she said. "Practically petty cash. You could blow up a *hundred Dervishes* and *still* qualify as a cheap project. I doubt you'll blow up more than two or three more before you get it right. Don't you realize that flight was 99 percent successful?"

Jake and I exchanged glances, then blinked as it suddenly dawned on us she was right.

"What's your angle in this?" I asked.

"I broker launch services. Trouble is, I'm locked out of large segments of the market. The big boys run the show. I'm left picking over the scraps, spot-marketing little pieces of left-over launch capacity. I could make a *mint* if I had a reliable, cheap, low-lead-time launch service to market. This isn't just my money, by the way. Several of my clients put up the bulk of it. Some of 'em are having to wait *years* to get their payloads up. At this point, paying you to develop a new

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system is just as quick, maybe quicker, than waiting in line, and the development costs are less than they'd have to pay for a single launch with anyone else."

Jake broke out another bottle of apple fizz, and we toasted the rebirth of *Dervish*. Then, Clarissa announced she had business in Vancouver the following morning, and had to be on her way. We shook hands, and she left. As she pulled out of the driveway, Jake reached for his tool-kit. I walked beside him as we headed for the barn.

"What ya think we should call *this* one, Tom?"

"The *Phoenix*?"

"Fee Nix? I don't think so." He patted the shirt pocket with the check. "How 'bout 'Taz'?"

I nodded. "I *like* it. Easy to spell, too."

Jake took a mock swipe at me. "I wonder if Warner Brothers will license the nose-art?" ■

All of the characters in this story are fictitious, including Jake and Tom. Some have real-world counterparts. The author gratefully acknowledges the tremendous contributions of James Victor-Hugo Hill, whose correspondence over the past year has provided much of the technical detail, color, and even a bit of dialogue.

We welcome your letters, which should be sent to *Analog*, 1540 Broadway, New York, NY 10036. (CompuServe: 71154,662. Internet: 71154.662@compuserve.com.) Space and time make it impossible to print or answer all letters, but please include your mailing address even if you use e-mail. If you don't want your address printed, put it only in the heading of your letter; if you do want it printed, please put your address under your signature. We reserve the right to shorten and copy-edit letters. The e-mail address is for editorial correspondence *only*—please direct all subscription inquiries to: 1-800-333-4561 or write: P. O. Box 5133, Harlan, IA 51593-5133.

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Cover artist Jim Burns is proud to be an illustrator. His mastery of technique would permit him to be a gallery "fine artist." Instead of drawing on personal angst, neuroses and whatever impels often tormented souls, Jim's inspiration comes from manuscripts. He does outstandingly well what many SF artists never achieve: portraying gigantic alien edifices, baroque cityscapes of the future, or gorgeous barbarian women *convincingly*.

Rendering imaginary visions convincingly cannot be picked up quickly, nor can the underlying technical competence. These are hard won after years of thought, study, and application. Aspiring SF illustrators asking Jim's advice may sometimes show acceptable technique but invariably produce such mundane illustrations that he thinks they simply lack an essential ingredient—too many over-endowed barbarian girls come across in smeary flesh-like tones when they need to look human.

A resident of England, now residing in Bradford-on-Avon, Jim is Welsh, leaving Cardiff only when eighteen. Trained by the RAF as a pilot in piston and jet aircraft, he thankfully withdrew from flying school after soloing and entered art school. A first year in basics in South Wales was followed by three years in graphic design and illustration at St. Martin's College of Art in London. Assignments and business details are arranged by agencies in London and New York. Additional income comes from sales of originals commissioned for publication through a Washington, DC gallery.

His first visit to the US was in 1980, while working with director Ridley Scott in Hollywood on *Bladerunner*. His wife, whom he met in art school

Photo by Mary Q. Smith

Jim Burns

and describes in terms suitable for a barbarian-girl model, says he came back ten weeks later an entirely different person.

Jim's first commissioned *Analog* cover was for Mid-December, 1992, 20 years after his first professional sale. This cover exhibits Jim's trademark: highly detailed, photo-realistic

(Continued on page 280)

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Tom Ligon

PROSPECTUS

Your chances of solving a technological problem depend on the scientific constraints and on how you go about it.

Editor's Note: This science fact article is a companion to the story "Amateurs." The story should be read before *this article.*

Jake Knoll is a fictitious character. James Victor-Hugo Hill, Ph.D., and Aerodesic Research, are for *real.* Dr. Hill and his Loyal Techs really *are* attempting to build a small SSTO spacecraft in a barn, complete with all-new engine technology, for a prototype cost of $1.5 million. He actually believes he can offer profitable launch services at $270 per pound *or less,* compared to the going rate of $6,800/pound. In fact, on his proposed, larger, follow-up craft, he thinks he can get it down to $70 per pound *or less!* A year ago, if I had dreamed up "Amateurs" as a story idea, I would have rejected it, or maybe added a dragon or fairy or two, and sent it off to a fantasy magazine. I have a *vivid* imagination, but I have my limits.

Let me start out by saying this is not a prospectus for a stock offering. Aerodesic Research is hoping to get by without selling stock. This is a prospectus for a concept of doing business that is alive and well in this country and elsewhere, which built aviation and the rocket business, and which is sorely needed in space endeavors today.

I also want to assure Jim's neighbors that, unlike Jake Knoll, Jim intends to launch legally, from a specially-built installation in the Caribbean, eastward over water. Please don't come after him with pitchforks, or post a guard at the airport. And if you hear a strange shriek and see bright lights from his farm, or maybe hear the occasional bang, well, he's doing some impressive science over there, stuff NASA hasn't even pulled off, so be *proud.*

I just think Jake's approach makes a fun story.

Two Ends of the Spectrum

The NASA Space Shuttle, the STS, was designed and built through an

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enormous effort by NASA and the aerospace industry. The number of people involved, and the expense, are simply mind-boggling. Even routine launches of the STS require nine to fifteen thousand people and half a billion dollars or more (3).

Why is that? After all, a rocket is a simple machine, right? A little gunpowder or similar mix in a tube, open at one end? Or maybe a liquid fuel and a liquid oxidizer squirted into a pressure bottle, also open on one end, where they react with great heat and pressure and rush out the opening. Newton's laws do the rest. Simple.

So why is the STS billed as the most complex machine ever built? Why can't we build an airtight can with the appropriate windows and hatches, attach a rocket motor, install a few radios and an air supply, and go flying?

There was a time, not too long ago, when that was pretty much what we did. The Bell X-1, the first manned aircraft to exceed the speed of sound and stay in one piece, was a remarkably primitive machine. Little more than a streamlined can with wings, tail, fairly conventional control surfaces, two tanks, and a cluster of four small rocket motors, the X-1 accomplished what many considered impossible. Read Chuck Yeager's autobiography, *Yeager,* for an account of the project (2). Jack Ridley and his team worked under primitive conditions with a remarkably small budget. A single battery powered the entire X-1 electrical system, and the plane was nearly lost due to a problem with dirty battery terminals. On one occasion Jack and Chuck fueled the plane partially for a ground-level takeoff by balancing it on a pair of jacks and some timbers. (This was necessary because it had no fuel gauges, and the landing gear would not handle a full load of fuel.)

Of course, we now know that is a foolish way to do aerospace research. You see, research laying the groundwork for the exploration of space is serious, *dangerous* business. Major program science. Reliability imperative. Lots of rules to follow. Lots of careful tests to run. No room for amateurs or sloppy science. And *expensive.*

Why the blank stares? Oh, sorry, I forgot, I'm preaching to the choir. Well, say *hallelujah*, brothers and sisters! You *believe* in cheaper spaceflight! Lord knows, I've seen you at Brother Stine's revival meetings, with Arlan Andrews and Robert Zubrin and Mitchell Clapp and a host of others singing harmony close behind. You cheered for the DC-X, you sang the praises of Black Horse. . . .

But, just how cheap can you get?

Big Company Foolishness

I apologize in advance, because I'm about to trash some folks who, in truth, do very good work, and have excellent reasons for the ways they do it. They aren't stupid, they just work in a system that is structured and motivated differently than a small-scale entrepreneurial or amateur effort.

In a large high-tech company, the people working back in the labs rarely have any management voice. Between them and top management are several layers of mid-managers and various

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departments. Accounting cares about billable hours, balance sheets, and whether each individual project is within budget. Marketing thinks the important thing is sales. Department heads may believe the important thing is for them to look good to higher-ups, while proving they are in charge to their underlings. Somewhere in there, the players can lose sight of the goal, which is to build a product, or provide a service, the customer *likes*.

The single most important advantage of a small, service-oriented business is that the management provides the product or service *directly* to the customer. Frequently, the same person designs, builds, and services the product, and receives direct feedback from the customer. If the customer is unhappy, that person can correct the problem without worrying about accounting bitching about overspent projects. There is no pressure to blindly try to follow a marketing department's wishful thinking, or to satisfy some unyielding manager trying to meet criteria set down by higher-ups. Instead, they can work directly with the *customer*, finding solutions that *work*. The only thing that matters is customer satisfaction, and artificial obstacles to delivering that satisfaction are largely removed.

Efficiency is often touted as a benefit of a large organization, but the opposite is frequently true. How many corporate employees does it take to change a light bulb?

1. The person who notices it and writes up the request.

2. The secretary who processes it.

3. The supervisor who signs the request.

4. The department head who approves it.

5. The mail-person who delivers it.

6. The maintenance secretary who processes it.

7. The maintenance department head who approves it.

8. The electrical supervisor who assigns it.

9. The electrician.

10. The electrician's helper (union rules).

11. The safety inspector who follows up.

12. The stock clerk who provides the bulb.

13. The stock analyst who checks inventory.

14. The purchasing agent who bought it.

15. The accountant who paid the bill and entered the labor hours.

16. The auditor who checked the accountant.

I could go on, but you get the idea. It can cost well over a hundred dollars to replace a light bulb at some companies. In a small outfit, someone picks up some bulbs on the way home, is paid from petty cash, then gets the ladder and changes the bulb. An amateur skips the hassle of getting repaid.

How many NASA employees does it take to breed a few rats? I was at Goddard Space Flight Center recently, waiting for a colloquium to start, and watching one of the many TV monitors hanging from the ceilings. They were showing a press conference regarding an upcoming STS experiment in which rats in the third trimester of

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pregnancy would be carried on the Shuttle to see if space flight would induce abnormal development. This, I gather, is important to judge the feasibility of experiments proposed for the Space Station. Fair enough.

The fellow giving the conference was quite proud of the size of the effort, which would involve *eighty* people. Yes, eight zero! And this was the leaner, more efficient NASA of the spring of '95! Now, where I come from, this would be a nice job for two graduate students and a good lab technician or two, although I suspect it would make a good science project for a really sharp high-school student who isn't too squeamish. (The project is not good news for the rats.)

If this story dismays you, take heart. There were a number of NASA employees waiting for the colloquium to start, and they were dismayed as well.

There can be some good reasons for expending this much effort, of course. If the mission cost is quite high, it may make sense to expend a great deal of effort to assure that all goes well. But, if the mission cost could be greatly reduced, you could afford to try, fail, and try again, at a tiny fraction of the cost per attempt.

Amateurs and Small Enterprise

Small business and people working on their own, without enormous resources, find some good, straightforward, economical ways to do things. I'm going to discuss the aircraft industry, particularly the homebuilt kit industry, which is both a good example of the sort of ingenuity I'm promoting here, and of the forces at work that resist innovation.

I will start with a sexy commercial production aircraft design, the Beech Starship. If you're not familiar with it, the Starship is a radical departure from conventional design, and has been featured on a number of aviation magazine covers. A twin-engine business turboprop, it features a large, swept wing at the back of the fuselage, a small forward canard wing, pusher propellers, and composite construction. The plane started, essentially, from a clean sheet of paper. I have seen estimates of 250 to 500 *million* dollars of R&D and tooling costs for the aircraft.

The folks at Beech will want to strangle me for saying this, but, so far, the Starship is a failure. Sorry guys, but how many did you build before you put the program on the shelf? About fifty? Now, there is nothing bad about the design, and it may even eventually succeed. I *hope* so, because it is a nice airplane. However, its performance is not in keeping with its appearance: it looks more like one of Von Braun's early Moon rocket models than the stable, easy-riding, efficient business conveyance it was designed to be. It is an attention-getter in a market that caters to anonymity. For those looking for status, it isn't the icon they want to click on. For those looking for a known quantity before they invest four and a half million dollars, it is an unknown value. For those looking for a sexy space-rocket, it is a dowdy old-lady airplane dressed in a mini-skirt.

The Starship is a *perfect* example of why the production aircraft business

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moves so slowly, evolving old designs a little at a time, avoiding the risk of investing hundreds of millions of dollars developing and certifying an all-new design that might flop in the marketplace. Perhaps the Starship will succeed eventually, as it gains a track record, but the history of the plane so far is *bound* to be causing a certain amount of board-room finger-pointing.

The Starship has a kitplane counterpart, a Burt Rutan design called the Vari-eze. A similar configuration, though much smaller, the Vari-eze is a fairly low-cost, fast, sporty, composite, single-engine kitplane that can be built relatively easily. It has spawned a number of look-alikes of various sizes, prices, and power ranges. Most kitplanes start as an amateur design, or are designed by a small team of professionals working under fairly primitive conditions at a small facility. The company president will be out carving foam, laying up composites, sweeping the floor, and scrubbing the toilet, right alongside of the company vice-president and the *other* two employees. Once the prototype is built and tested, they fly it to Oshkosh for the biggest air show on Earth, and take orders. With enough orders in hand, they come home and set up a factory, typically a good-sized hangar with a handful of employees. The prototype development costs can be as low as a few tens of thousands of dollars (about the cost of a kit and some flying time), and a lot of sweat equity. A lot of these efforts fail, with about the same financial consequences as a gas station going out of business.

Burt and Dick Rutan's Voyager made history a few years ago, flying non-stop around the world, without landing or refueling. This revolutionary accomplishment started with a clean sheet, including new engines and a featherweight airframe (foam and composite), which allowed tremendous fuel capacity and ultra-low drag. Development cost was a few million dollars, and it was built by a small team.

Another small firm, Aurora, is building high altitude unmanned research aircraft. Perseus has already flown, and its much larger cousin Theseus should fly about the time this is published. Capable of reaching eighty thousand feet, the same cruising altitude as the U-2 and SR-71, these lightweight, long-winged planes are propeller-driven, using highly modified piston engines! Aurora's engine test facility is located in an old hangar the city of Manassas, Virginia was about to tear down. Built with more sweat than money, the facility is tremendously impressive, with a high-altitude test chamber in which the powerplants can be operated. They've destroyed a few prototypes in it, as G. Harry Stine says you must (6). Their composite construction is similar to the methods Dr. Hill is using. The company founder, Dr. John S. Langford, directed the Daedelus human-powered aircraft program, and worked at the Lockheed Skunk Works.

An impressive academic exercise that flew successfully, Daedelus might well be classified as "amateur," with low cost and a lot of volunteer effort. Voyager's roots are deep in the kit-

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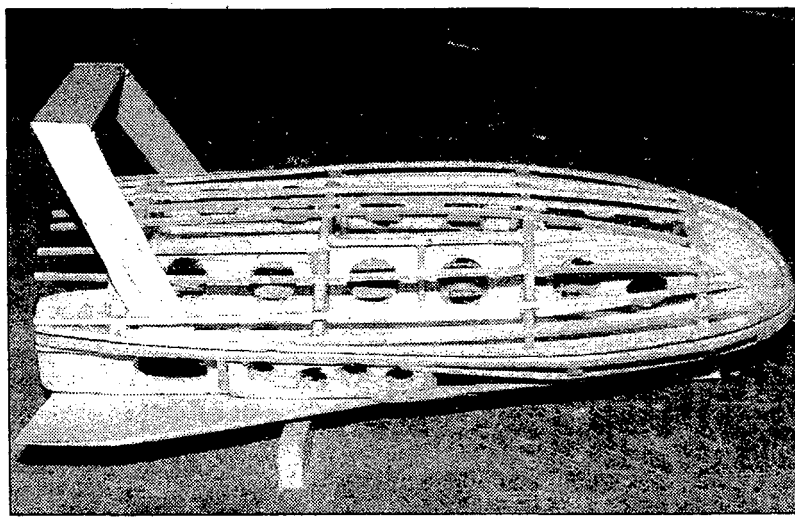

Model and photo of Jim Victor-Hugo Hill's "Jeremy/Puffin" Spacecraft by Douglas E. Drummond.

plane realm, and could be tarred with the same brush. Like the other programs I am describing here, the description reflects love of what the participants are doing, plus a small-scale, hands-on, results-oriented effort, rather than any lack of knowledge or ability. Their results speak for themselves.

Several major factors drive the kitplane business, which are vastly different from the conservative forces driving the factory production aircraft industry. Individual kitbuilders tend to fairly single-mindedly concentrate on a couple of these factors which are:

1. Low construction and operating costs.

2. Ease of construction.

3. Performance, particularly speed and aerobatics.

4. Distinctive appearance.

What sold ten years ago in the production aircraft business will probably still sell in another ten years with only a little modernization. Not so with the kitplanes. The Glasair from my story was a hot-selling performance kit a few years back, but the company that built it has recently dropped it in favor of a low-cost, easily-built utility plane, letting the newer, hotter Lancair and a few others scrap over the performance market. By the time this is published, the Lancair could be yesterday's news. Competition is fierce, and development is rapid. However, these small companies are flexible, and can reengineer and turn out a new design far faster and cheaper than their production counterparts.

And, working quietly in the background, are the folks like my friend who is building the all-wood plane of his own design. He has no plans to sell kit copies of it. He simply *loves*

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doing it. Most of the costs have been in the engine, instruments, and radios. The years of work are, for him, a pleasure.

Many of the same forces that paralyze development in the production aircraft business, also hold back the development of radical new technologies for space transportation. There are many clever, workable ideas out there for electric rockets, solar sails, etc., that have never been put to use. Exotic, high performance engines with features like Dr. Hill's are not entirely new, or even untested. They are simply untrusted new technology. Instead of trying them, we keep sending up liquid-fueled rockets derived from the V2, supplemented by solid rockets, because they have a track record. With the high cost of each flight, and the expensive risks of any "clean sheet" design, the pressure is strong to evolve designs a small step at a time.

Can Dr. Hill and the Loyal Techs of Aerodesic Research really design and build a small, composite SSTO for $1.5 million instead of the 100 to 200 million it will take to build Black Horse (7) or the X-34 (9)? He has figures that seem to back it up. Furthermore, the disparity in development costs are less than the disparity between the development costs of an all-new production business aircraft and a kit-built 4-seater. Dr. Hill and his crew aren't building a Starship, they are building the equivalent of a Cessna 182 capable of Low Earth Orbit.

Risk

Because their development costs are low and their composite-fabrication methods are so readily adapted to new designs, small kit aircraft companies are willing to risk failure. If a prototype doesn't fly well, they change a few dimensions and it *will* fly. No major re-tooling is required at the prototype stage. If it gets beat in a race against a competitor, they clean it up, put in a bigger engine or a new prop, and come back the next year. If they get beat again, they invent a new game they think they can win.

They also risk death. One small company, testing a new composite jet kit, has lost two aircraft, and their test pilots, about six months apart recently. Each pilot was also the company president at the time of his death. The first was pushing the aircraft faster than it had ever gone before, "expanding the envelope" in Chuck Yeager fashion. The second apparently died when a small part broke during a landing attempt. Neither crash made national news, except for fairly small articles in the aviation press. No national prestige was riding on the crashes, just the fortunes of a small company, and the grief of a family and friends.

This is not to say nobody cares. All pilots hate to hear about losses like these, but they understand that it happens sometimes. The people involved care very much. These test pilots take great pains to design test programs that adequately explore the characteristics of their designs, while giving them the greatest safety possible. If they thought they were doing something that would surely kill them, they wouldn't do it. However, they know that they are always doing something

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that *might* kill them, and do a personal risk/benefit analysis. Sometimes their answer is wrong.

The government agency charged with regulating aircraft, the Federal Aviation Administration, has special rules for experimental aircraft. These rules are considerably relaxed from the stringent rules for production aircraft. They exist to allow experimentation and progress, and they do just that. However, it is acknowledged that these aircraft may have more unexpected problems than the ages-old production models. The FAA takes the general attitude that pilots may take a lot of risk, so long as they don't endanger their passengers or the general public, and this goes double for anything with EXPERIMENTAL stenciled above the door.

Are the lives of astronauts worth *more* than the lives of test pilots, or ordinary citizens? Certainly not, but you would think so to see the response to the 1986 Challenger explosion. Nearly a thousand people died in general aviation accidents that year (10). We kept flying. Around fifty thousand people died that year in automobile wrecks, and we didn't stop driving.

Each person must decide how important their own life is, and how they must live it so that they can feel it *is* important. I caught some flak a few years back from a reader who thought a tornado research plane featured in "Funnel Hawk" (June '90 *Analog*) was just too dangerous a thing to be considered, and it would be on Stan Schmidt's and my head if anyone ever died doing something so stupid. That's her choice. My choice is that I give thunderstorms a *very* wide berth, but I *fly,* and a lot of people would judge that foolhardy. I would go into space in a minute if I thought the ship had a reasonably good history of reliability. Somebody has to fly it first, and they would be well advised to weigh the risks and benefits thoughtfully, whether the ship is based on billions of dollars of government research, or a million and a half of amateur-built dreams.

Home-Built Experimental Rockets

At present, this field is primarily limited to model rocketry, using solid-fuel motors from Estes and others. This is a good training ground for rocket principles, range safety, and perhaps telemetry, fairly affordable to most anyone interested, including well-motivated youngsters.

The story "Touch a Star" by Mike Moscoe (February '95 *Analog*), involved a liquid-fueled rocket (which used concentrated hydrogen peroxide as the oxidizer) operated by students under moderately stringent supervision by a junior high school science teacher. The young protagonists came up with a scheme for souping up this low altitude trainer so that it could make orbit. (Dr. Hill *loved* the story, by the way, Mike.) I know of no existing rules that would permit such use of a liquid-fueled rocket today.

Very few amateurs in this country have followed in Robert Goddard's footsteps, building and flying liquid-fueled rockets. The present rules don't allow it. Some amateurs in Germany did, including Wernher Von

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Braun. Those amateurs went on to build the V2, which is the technology on which both the US and Russian space programs were built.

A few non-flying liquid-fueled rocket systems may be in reach of amateurs and small businesses. The technology is not out of the question for use in isolated areas, for land or water speed records, though it would be quite dangerous in case of a crash. Generation of enormous amounts of electrical power for short periods of time is possible using magnetohydrodynamics. Certainly, small experimental engines tested in static installations should be possible by amateurs or small firms, with adequate safety precautions and in isolated areas, and could allow exciting new approaches to be tried.

Establishing rules to allow small research teams to *fly* their rockets will be the tough part. Presently, NASA is bound to become heavily involved. Involving only a few NASA employees can easily run into tens of millions of dollars, and those employees, fearing that a failure will reflect on them, are likely to want to impose the same sorts of test programs that NASA itself uses, running costs up into the hundreds of millions of dollars. The small programs need something more like the experimental aircraft rules.

Fuel Costs

When most of us take a trip, we pretend it only costs us the gas in the tank. For most existing launch programs, fuel cost is a very small part of the cost of a launch. In the case of the STS, it is almost a negligible part of the half *billion* or so each flight costs (3).

Fuel cost provides a limiting case, so we'll use it as a starting point. One major question is, how much fuel does it take to get to Low Earth Orbit (LEO)? The traditional way this is posed is how many pounds of fuel does it take to get a pound of payload into orbit. Two basic factors come into play here: how much does the rocket weigh, and how potent is the fuel? Once we know how much we need, figuring the cost is just a matter of getting bids.

Rocket fuel is generally remarkably cheap, although the price is highly variable, and the examples below are approximate. Zubrin and Clapp (7) gave a price for liquid oxygen of 5 cents a pound, cheaper than bagged ice! Through a local supplier, I can get it for a little over 11 cents a pound. Jet kerosene, at $2 per gallon at the pump, works out to 33 cents a pound, and large quantities are even cheaper. Liquid hydrogen is more expensive, at around $1.35 a pound, and it is expensive to handle, with high evaporation losses and explosive vapors.

The X-34A uses 49,200 pounds of propellant. If we assume an oxidizer/fuel ratio of 2.6:1, this gives about 19,000 pounds of JP-4 jet kerosene and 30,200 pounds of liquid oxygen, for a propellant cost of $9,652. OSC says each launch will cost around four million dollars (9).

Let's recap the fuel potency issue by going over a few of those earlier *Analog* articles I referenced, plus OSC's new X-34 (9), and a hypotheti-

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System	Fuel System	I_{SP} sec	Payload Fraction	Cost/lb to LEO(est)
STS	Lq H_2/Lq O_2	460	1.48%	$6800
DC-Y	Lq H_2/Lq O_2	450	1.54%	500
X-34A	Kerosene/Lq O_2	355	1.57%	3300
X-34B	Kerosene/Lq O_2	355	2.30%	
Black Horse	4 candidates:			
	Lq H_2/Lq O_2	450		
	CH_4/Lq O_2	385		
	RP/Lq O_2	355		
	JP-5/H_2O_2	330	0.78%	?
Liquid Ozone	Lq H_2/Lq O_3	607	——	
Aerodesic	Jim ain't telling!	600+	5.36%	270 to 68

Sources: (1), (3), (7), (8), (9), (11), (12)

cal system from *The Starflight Handbook* (11). The figure of merit we're using here is specific impulse, or I_{SP}. Each machine below addresses the SSTO approach to some degree. The X-34 will be air-launched and suborbital, releasing an expendable upper stage to put a payload in orbit, and is a test bed for the orbit-capable X-33, which is on the drawing board. Black Horse is a design which would launch partly fueled, then take on propellant from an airborne tanker (7). The STS can clear the pad only with the help of powerful solid rocket boosters, and drops an expendable external tank. Only the DC-Y (3) and the Aerodesic craft are true fully recoverable unassisted SSTO's.

Like Dr. Knoll in the story "Amateurs," Dr. Hill believes he can achieve a higher specific impulse than the present competition. How? He won't let me give exact details, and truthfully he is still fiddling with the systems, but the principles are basic. You have to run the engine hotter. Any of the fuel systems above has an amount of energy it will produce per unit mass of fuel (kilocalories per mole divided by molecular weight). If all of that energy can be applied to the reaction products, you can calculate an exhaust velocity, V_{EX} (energy equals 1/2 mass times velocity squared). I_{SP} is a function of V_{EX}.

The STS manages to use close to 80% of the available energy of its fuel (1), liquid hydrogen and liquid oxygen. In part, this is because the engine is cooled by the liquid hydrogen fuel, which is very cold, so the reaction can be allowed to run quite hot. They also use extra hydrogen, which reduces

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the average molecular weight of the exhaust, increasing V_{EX}. Sneaky, but in the process the thrust to mass ratio suffers. The STS needs solid rocket boosters to help it get off the ground, partly for that reason. The DC-Y, which will weigh about a third as much as the STS at liftoff, will also use liquid hydrogen/oxygen, but will use eight engines of similar thrust to the three on the STS (3). Some other engines and fuel systems suffer from some combination of less chemical energy available, materials limitations of the engine (they can't run hot enough to put all the available energy into the reaction products), slow reaction rates that release much of the energy well *behind* the rocket, and high molecular weight of the reaction products (giving low V_{EX}). Nozzle shape must be compromised on conventional designs, since a nozzle which is efficient at sea level is inefficient at low atmospheric pressure, and vice versa.

Dr. Hill and his loyal techs are trying some fresh approaches, including tripropellants and exotic fuels. The basic idea behind this approach is to use fuels that are "wound too tight," i.e. they carry extra energy in their chemical bonds. Hydrogen peroxide is a classic example: catalytic decomposition of hydrogen peroxide by itself can produce an I_{SP} of about 160 seconds, enough to power James Bond's rocket backpack, reaction control thrusters, or the turbine pumps of early liquid fuel rockets. Other examples, which Dr. Hill may or may not be using, but which have been looked at or used for rocket fuel, include ozone (O_3), boron hydride (BH), nitroglycerine, nitrogen pentoxide, and hydrazine. As you might guess, they can be a bit touchy to store and handle. Aerodesic's propellants will cost from about $1.50 a pound (with on-site processing) up to around $15 a pound for off-the-shelf chemicals for the first few flights. Although his fuel is expensive, it is offset by a much better payload fraction and easier fuel handling (no cryogenic fluids to worry about).

Reaction temperatures can be elevated in two ways: by designing the engine to operate at higher pressure, and by some sneaky tricks to increase reaction rate, which I am not at liberty to discuss. These result in higher exhaust temperature, and consequently higher V_{EX}. In fact, Dr. Hill believes he can get temperatures far above the capabilities of any known material to contain them, so his engines would self-destruct in seconds if they were of a conventional design. If you've been keeping up with proposals for nuclear and electric rockets, which may have I_{SP}s in the tens of thousands or hundreds of thousands of seconds, you know there is a method for handling such temperatures: magnetic confinement. Is that what Dr. Hill is using? Could be he's having me blow some credible-looking smoke so you won't guess how he *really* does it. Whatever the trick, the exhaust is directed out the back of the rocket in a much tighter, more efficient stream than conventional designs achieve.

And before any of you know-it-alls get in a snit and claim the whole idea is preposterous, get a good book on

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an old industrial process, related to arc-welding, called "plasma spraying." Behold the awesome temperatures the little copper rocket nozzles used for that process withstand, with virtually *no damage!* They handle hotter stuff than Dr. Hill's rockets produce!

Aeroshell Mass

The other big performance factor is the dry weight of the rocket. Obviously, every pound of weight you can remove from the rocket is another pound of payload capacity. How light can you make a rocket? Dr. Hill believes a composite and foam structure can be produced, with sufficient strength for orbital ascent and reentry, at on the order of 2 kg/m^2. Compare this to a typical aluminum aerospace structure of 12 to 16 kg/m^2 (1). This featherweight system should not only allow extra payload, it reduces aerodynamic loading on reentry so that the craft can *fly* back rather than making a meteoric reentry. This reduces the need for heat shielding, heavy stuff that robs payload fraction. Combined with a few friction-reducing tricks, he thinks it will do the trick. Is he right? OSC and McDonnell Douglas seem to agree. The X-34 and DC-Y will have composite aeroshells. The DC-X aeroshell was built by Dick Rutan's Scaled Composites, based on experience building kitplanes, Voyager, and a number of proof-of-concept prototypes for production aircraft.

If you combine a high-performance propellant system with a light aeroshell, you should get a large *payload fraction*. That is, more of the weight you are putting into orbit is stuff you are getting paid for. That's where a major part of the payoff comes. If two companies both pay about the same for fuel and have about the same cost per launch, and one can get a pound into orbit using a hundred pounds of fuel, while the other can get five pounds into orbit using a hundred pounds of fuel, guess who looks happier at the annual stockholder's meeting.

Another major problem for rocket designs is "margin." When the projected payload is a small fraction of aeroshell mass, a small increase in aeroshell mass between design and construction can quickly wipe out payload capacity. The DC-Y will have an empty weight of 104,000 pounds, with 20,000 pounds of payload, which is a generous margin in this business. The X-34A will weigh 14,700 pounds empty, plus 11,200 pounds for the orbital vehicle, but the payload is only 1,200 pounds, a slim margin that could be eaten up quickly. Aerodesic's prototype will weigh about 1,300 pounds empty, and will carry about 660 pounds of payload. That is a *huge* margin, that can stand a little creeping up of the aeroshell mass, if necessary.

Other Costs

You must also, of course, take into account the cost of R&D to develop the design, plus the cost of building each ship, plus maintenance costs between flights, finance charges, and such little niceties as sales commissions, insurance, and profit.

When the STS was first announced, we were told it could loft 65,000

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pounds to Low Earth Orbit for $35 million, or about $538/lb, in about 1980 dollars (12). In fact, those numbers were always wildly optimistic, and the present launch costs are closer to half a *billion* bucks a launch (3), or around $7,700 per pound of payload. Part of the problem is that each orbiter makes it into orbit only about twice a *year!* The things are hangar queens, requiring a support crew of 9,000 to 15,000 people to keep them running.

In Engineering Economics, you learn the *time value of money,* i.e. you treat all up-front investments as if they are costing you interest, even if you paid with cash reserves. We will apply this below, using simple 8% interest on a share of the development and construction costs, plus a share of the principal.

OSC projects the costs for the X-34A to be in the neighborhood of $4 million per launch (9), with a payload of 1,200 pounds, from which I calculated the cost per pound. The fuel costs calculated above are around $9,700. The cost includes an expendable orbital vehicle, perhaps a million dollars? The turn-around labor is expected to take 15 people a couple of work-weeks, around $100,000 at $60 per hour. Allow another $20,000 for a couple of hours flying their L-1011 launch platform. Where did the rest of the money go? Amortizing R&D ($100-200 million) and construction costs over the fairly small number of launches each vehicle will see in its life, plus interest, account for most of it.

The DC-Y is expected to require up to 350 person-days of inspection and maintenance (3) ($168,000 at $60 per hour), and will put 20,000 pounds into LEO using 1,176,000 pounds of fuel. If you assume the H_2/O_2 fuel averages 50 cents a pound, or $588,000, then the DC-Y could fly for $756,000, or $37.80 per pound! But then there are those hundreds of millions of development dollars to worry about again, and only 20 or so flights a year. The interest on $100M alone would add around $400,000 per flight. If the craft flies 20 times a year over 10 years, that's another $500,000 per launch to amortize the principal, for a total of $1.656 M, or $82.80 per pound. Still quite cheap, but McDonnell Douglas is projecting more like $500 a pound. What are we missing?

Oops, I've left out an engine replacement allowance. There are eight of them, each as big as a Space Shuttle Main Engine. I wonder what they cost, and how many vertical takeoff/vertical landing cycles they can stand? And that 1.5% payload fraction could be quickly eaten up if the aeroshell mass goes up significantly, or the engine performance is lower than expected, playing major havoc with the economics (ask Burt and Dick Rutan if the Starship lived up to the performance of their proof-of-concept prototype). And then there are all those light bulbs to be changed back at corporate headquarters. The Delta Clipper *sounds* like it could be a good bet, but there are some traps in this business that can catch you off guard.

For truly economical operation, we need to get away from spaceflight being a Big Production, with months of planning and preparation by ten thou-

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sand people going into each launch. Dr. Hill thinks, for a small craft using his novel low-damage engine technology, it can be done in a few hours by a couple of technicians ($360), allowing as much a *two flights a day!* The development costs, already low, are spread over a very large number of flights, and interest charges per flight become very small.

The airlines operate hundreds of aircraft costing tens of millions of dollars each, and some big jets exceed a hundred million. The airlines know that they cannot afford to have their billions of dollars of capital investment sitting idle, running up an interest bill (nearly $220,000 a day per billion at 8%) with nothing to show for it. Their aircraft spend considerably more time flying than they do in maintenance, yet they operate more safely than any other form of transportation. Despite NASA's claim about the complexity of the STS, a modern turbofan engine is probably *more* sophisticated and precisely made than even the Space Shuttle Main Engines, and is *far* more complex than the average rocket motor. The overall instrumentation, hydraulics, auxiliary power systems, fuel systems, navigation, communications, *and life support* systems of a modern airliner are probably on par with the complexity of the STS Orbiter, and the electronics are, in fact, *more modern and sophisticated.*

Imagine a craft like the DC-Y, but which could be turned around in eight hours by a crew of ten, making a flight a day. The same $588,000 in fuel, plus $4,800 in labor, $22,000 in interest, $35,000 against principal, gets us down to $32.50 a pound of payload! This is an underestimate: costs which were virtually negligible before become far more important, but you get the idea. Reducing the cost to nearly the costs of fuel requires quick turnaround and lots of flights.

So, *there* is the real key to spaceflight economics! Keep 'em flying! There are craft on the drawing board right now that could get into orbit at the price Dr. Hill believes is possible, if only they could be operated like airliners. His numbers are *not* unrealistic pie-in-the-sky, in fact, they aren't that much lower than the original numbers for the STS. The X-33 and Delta Clipper could probably come close if their maintenance and life-cycle costs can be kept under control. It's just that nobody has yet managed to turn their ships around like airliners. In part, that's because *every last one of them* are using engine technology derived from expendable launch vehicles, which have to be inspected vigorously after each use, and refurbished or replaced frequently.

Who Does This Guy Think He's Fooling?

Perhaps only himself. However, I certainly hope Dr. Hill is right. Look at those present costs per pound. Now, multiply by your body mass, adding a substantial allowance for life support, assuming you're interested in continued breathing. At tens of thousands of dollars a ticket, you might hope, with diligence and moderately good luck, to be able to afford a trip up some day

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on one of Aerodesic's craft. On anything flying today you will need to win a really big lottery. The fact is, if Dr. Hill's basic economic assumptions are not correct, space travel will always be severely hog-tied by the enormous cost of getting to LEO.

The important thing is *to let him try it!* We've been nibbling away at the cost of space travel from the top, replacing extremely expensive Saturn V's with the STS, etc. The rate of approach to airline economics is excruciatingly slow. Isn't it time somebody tried to see just how cheaply it can be done? Who better than a team of "amateurs," doing things the simple, old-fashioned way, with a small team, scrounging, and doing it as a labor of love? I suspect the larger aerospace firms, like the big aircraft companies, are nearly incapable of true revolutions. Revolutions require amateurs.

Will the big boys let him play this game, or will the Powers That Be decide that spaceflight is over the heads of amateurs? This is something to watch, brothers and sisters. This may be a subject that will require us to raise our voices in unison, demanding that the "amateurs" be given the chance to risk their own necks to attempt to prove their points. Be ready.

As I said, Dr. Hill isn't interested in selling stock. However, if some of you knowledgeable amateurs are interested in lending a hand as Loyal Techs, or just want to discuss the idea, I have set up a category called Cheap Rockets, under *Analog/Asimov's* area in the SF/Fantasy Literature forum of Compuserve. You can also reach us by e-mail at:

102707.3164@compuserve.com (Tom Ligon) or:

0001998364@mcimail.com. (Dr. Hill).

If some of you have space applications you have been hoping to pursue that won't work at $6,800 a pound, but would be feasible at $270 a pound or less, get in touch! Even for those of you who regularly send payloads to space at higher prices, it might be worthwhile to look into possible future savings.

Or, perhaps some of you would like to go into competition with Aerodesic. The door may be open for clever amateurs.

Is this a long-shot gamble? Certainly. Opening any new business is a long-shot gamble. New space ventures are risky. On the other hand, opening a new business is legal in all 50 states. You don't have to make those travel arrangements to Atlantic City or Lost Wages! Besides, at 1 percent of the development costs of similar projects, this is really a small risk. Think of it this way: if a lottery ticket with million to one odds has a price of a dollar, and the jackpot is a hundred million, wouldn't *you* buy a ticket? The odds are long, but they are *good!* ■

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About the Author

Tom Ligon's first science fiction story appeared in the September 1984 *Analog*. Since then he has published seven other stories, plus the current story and fact article, all in this magazine. Like the narrator, Tom, in "Amateurs," Tom Ligon is a private consultant, whose services range from nuclear science to consumer product safety, and he enjoys flying. A generalist rather than a specialist, Tom holds degrees in Biology and Electrical Engineering Technology, and has work experience ranging from technical writing and air pollution instrument design to materials testing.

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Some new things, once started, tend to . . .

SNOWBALL

Jeffery D. Kooistra

Illustration by Steve Cavallo

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I would have been preaching at that time on Christmas Eve, preaching some variation of my usual holiday sermon. But a huge blizzard had blown in, canceling my service for that night, and for Christmas day also. Instead, I was sitting in front of a toasty fire, drinking a cup of hot chocolate with marshmallows, and watching the news, waiting for a weather update.

The anchorman did a story about a warehouse burning down earlier in the day. I was relieved to discover that no one had been hurt, although a number of stray cats had been seen fleeing into the driving snow. The weather update came on and the weatherman joked about "cold kitties" being out there for the next few days, but that the worst of the blizzard should blow through by Christmas night.

Rudolph's nose would have to glow extra bright for Santa to make it through that storm.

I could hear the wind beating the shutters against the sides of the church, whistling through the bell tower; the sound echoed throughout the sanctuary. The apartment my dear wife and I had shared for so long (the Lord took her three summers past) was built into the back of the church and the walls separating it from the church proper were thin, and some strange quirk in the architecture led to sounds being made in the church getting amplified by the time they propagated to my living room.

It was lucky for one little fire survivor that this was the case, or I never would have heard him.

I had nearly finished my chocolate and had shut off the TV so I could simply sit and stare into the flames when I heard a scratching at the sanctuary door and the hint of a weak "meow."

I thought of the cats from the warehouse fire immediately, and I got up and proceeded to the double doors that led directly into the back of the church.

It was quite a walk from my living room—my church is a big, rambling, old country affair, but I'm not so old as to have required more than half a minute to open the door.

A gust of wind blew through the opening, and with it rolled in a snowball, I thought. Then it stood up and "meowed" most vigorously, and I realized I was in the presence of a perfectly white kitten. I picked him up and he didn't protest, and cuddled up against my sweater. "I'm going to call you 'Snowball,' I think," I told him, and when I set him down in front of the fire he lay so close to the blaze that I feared he might melt.

I went to the kitchen briefly to get my guest a saucer of milk, and while there I prepared myself another hot chocolate. I warmed the milk first in the microwave. When I put it in front of Snowball he gulped it down most thankfully.

Settling back into my chair, I thanked the Lord for company that night. I had been lonely, I realized, now that I had a new friend to share the evening with. Christmas time is tough on those who have lost a mate, and my children are far flung—daughter is working at the new Moon base,

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I'm proud to say, and son is somewhere in the Australian Outback searching for a lost city.

Snowball finished lapping up his milk, then he turned to me and fairly bounded right onto my lap. "Well, you're certainly not a shy fellow," I quipped. He seemed mighty interested in my cup of chocolate, so I allowed him to peer over the brim. He fished out one of the marshmallows and had it in his mouth faster than I could say "Jack Robinson."

Taking the hint, I led him into the kitchen and warmed up a dish of leftovers for him, making sure I added a few marshmallows as a side dish.

We returned to the fire and when Snowball finished eating, he returned to my lap and promptly fell asleep. I allowed him the pleasure for an hour then carefully placed him on a pillow at the foot of my bed and retired for the evening myself.

I awoke to a room with drab winter light coming in from the windows, and momentarily feared that I'd overslept. It was Christmas morning and I had a church service to. . . .

But then I recalled the blizzard and that I had deliberately not set my alarm for six, and so took my time easing my creaky old body out of bed. At seventy I was old enough to retire from the ministry, but with my wife gone, there really wasn't anything else for me to do.

I also recalled the arrival of Snowball, but a careful look around failed to turn him up. I called, "Snowball! Snowball!" but I had only named him last night, and he would not have known I was calling for him.

I didn't worry about it. Mine is a large church building with a thousand hiding places for one so small as Snowball, and no doubt he would come around again when he was hungry.

Out the window, though the blizzard had subsided considerably, the wind still piled snow across the church parking lot and the street. I had no doubt that I would not be driving anywhere for several days.

I was wondering what I was going to do with myself, alone this Christmas morn, when I heard a noise.

The church is old, and it creaks more than I do, and it has a small but vigorous rat population in the basement, so hearing odd sounds is not uncommon. But I had lived there a good many years, and I knew my building's little quirks, and this noise was different.

It was a long series of delicate, padded thumps, like something light and springy was bouncing around. Of course, it must be Snowball, I suddenly realized.

Since the sound was coming from upstairs, I slowly walked up the steps to the balcony, careful to continue listening to the thumps so that I could better zero in on the origin of the sounds when I reached the second floor.

The sounds continued, then were joined by a single, louder thump. Silence followed briefly, then the sounds returned, but by then I had narrowed my search to the few rooms within the bell tower.

The first door I came to was the

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custodian closet. I opened it simply to be thorough and an ancient dust mop fell out sending up a plume that caused me to sneeze.

By the time I reached the second room the thumping had ceased. Nevertheless, I entered the room and enjoyed the memories that came flooding back, for this room had once been my Sunday school, and the old desks were still arranged in neat rows. My congregation only had a few children now, and the class was conducted on the main floor, but I remembered days when I had to teach two sections of Sunday school, and both times all the desks were filled.

I backed out of the room finally, still not having found Snowball, and was just about to open the last room when I felt a gentle bumping against my legs.

"Snowball! So there you are," I said. He was covered with dust and looked almost gray. I noticed that the dust was wet. I hoped the roof wasn't leaking again—that melted snow hadn't formed a pool somewhere above the ceiling.

The sounds had stopped with the reappearance of Snowball, so I returned downstairs with him scampering along behind.

Christmas night went much the way the previous evening had, although I did receive a delightful call of precisely three minutes duration from my Moon-dwelling daughter. We wished each other well and a Merry Christmas before her time ran out.

At half past eight, Snowball, who had been asleep beside the fire, awoke, stretched, seemed to glance at the clock, then ran to me and playfully attacked my slipper. I laughed and pushed him gently away, but he was persistent and in a show of surprising strength for a kitten, pulled my slipper from my foot and made off with it. He stopped and waited for me to pursue. I obliged.

Snowball proved to be a worthy opponent in this game. He would lure me to him, then duck under the chair and emerge from the back, trot along the wall, then taunt me from the hassock. I have earlier said that Snowball was a kitten, and indeed, he was the size of a kitten. But there was none of the tentativeness of kitten play about him; none of the awkwardness of fluffy feline youth. I wondered if perhaps he were really some kind of midget adult.

Snowball got the best of me. I had been running about the room oblivious of my age for several minutes when I suddenly had to stop and sit down. I caught my breath and was about to resume the game when I heard the noise again.

Now Snowball was right in front of me, so it could not have been him making the noise earlier in the day after all. I excused myself from him and once again made the trek upstairs, this time going straight to the third room. The noise stopped when I opened the door.

It was dark in there. I snapped on the light and looked amongst the dozens of boxes and old pews and Bibles with missing covers—the flotsam and jetsam of old churches. Despite my certainty that the noise had

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originated in this room, I could find nothing amiss, except for the hole in the ceiling that led, if one were tiny enough to pass through it, into the boarded-up top room of the bell tower.

I closed the door and walked around the corner to the narrow staircase to the upper room, at the top of which was a boarded-up door. I was of half a mind to retrieve my tools and open up the door right then when I thought I smelled smoke. The smoke alarm went off and I raced downstairs, thoughts of an investigation dropped for this more pressing matter.

Back in the living room I found that the throw rug from in front of my chair was half in the fireplace, and that flames had progressed it far enough for smoke to have escaped the chimney and gone wafting through the room. The easiest thing to do was simply to throw the remainder of the rug into the fire, which I did, and then I turned to find Snowball calmly licking his paws.

No doubt the kitty had dragged the rug up to the fireplace to sleep upon. Somehow the end had fallen into the fire. This had probably used up one of Snowball's nine lives.

I got the key to the smoke alarm from the cupboard and shut off the keening whine, then called the fire department to report that I had things under control. This turned out to be fortunate for them since they had barrelled out of the station in their truck, only to have it slide across the street and lodge itself in a snow bank.

I brought Snowball an old pillow that my wife had used as a pew pad and he slept in front of the fire that night.

I woke up in pain. Oh, it was nothing serious—just the aftereffects of my tussle with Snowball the previous night. When I'd gone to bed I had fully intended to investigate the upper room that morning, but now my body would protest even going up the stairs, and rebel completely if I tried to do any real labor.

Besides, it had probably just been the rats.

I've said before that my church is an old one—it goes back over a hundred years. Early in its existence it gained a colony of rats and became part of an ecosystem involving rodents, the local farmer's fields, and itself. Usually the rats are not much of a problem, confining themselves to the lower sections of the church and to hollows just outside the foundations. Only during harsh winters do they tend to congregate in the warmth down below to the extent that they become a nuisance.

Although they apparently had discovered some new passageway up into the bell tower, I decided to go into the basement to see if they'd again reached problem population. Over the years I'd developed a nice operational definition (a term I learned in a psychology class) for "too many rats." If I could go into the boiler room and spot two rats within the first two minutes, then I knew their population was too high. In ordinary times, one could wait over an hour without even hearing a rat walk by.

Snowball had awakened with me, so I asked if he'd like to join me, and

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he followed along. I retrieved my flashlight from the broom closet and set off down the stairs. Most of the basement is given over to abandoned meeting rooms and a kitchen with cobwebs in the cupboards, but the boiler room was fairly close to the bottom of the stairs, and we arrived at the door swiftly.

The door was unlocked so we went right inside, then stood quietly, listening. Snowball purred and bumped my legs, but he didn't seem interested in exploring the boiler area. I couldn't hear anything in the first couple of minutes, so I snapped on the light. No sign of rats here. I took the flashlight and poked into various nooks and crannies, but to no avail—there wasn't a rat in sight.

Now that was odd in itself—not to see any rats even when I went to look for them with a flashlight. I decided to take the stepladder from the corner and climb up to look in the crawl space. There were always rats up there. Always.

Despite the protestations of my stiff and sore body, I climbed the ladder and peered over the edge into the crawl space. It was dark in there so I shone the flashlight into the gloom. Nothing. No beady eyes looking back. Nothing scurrying away into the shadows. Not a rat anywhere.

There were, however, bones. Little bones. Pointy bones. Most looked to still have meat on them. I reached in and grabbed one of the nearer bones and looked it over. It was a leg bone, but the foot was still attached. The foot had yet to dry out, had yet to begin decaying and stinking.

Something had killed off all the rats in the past couple of days. I looked at Snowball. The rats I'd had in the past were his size or better, and Snowball was as unmarked as a kitten could be.

"This is most curious," I told him. "You aren't keeping secrets from me, are you Snowball?" I asked, but he wasn't talking.

I heard the sound again the next two days, always just after dusk. But these times it lasted for only a minute each time, and was gone before I could even decide to go upstairs to try again to find out its cause.

But it was in the dead of night on that second day that I finally discovered the origin of the noise, and Snowball's secret.

I awoke in the dark, fished my spectacles off the nightstand, and saw from the clock that it was two in the morning. I also noticed that Snowball was not sleeping at my feet, though these past few mornings I had always left him there at night and found him there in the morning.

Despite the hour, this was one of those late night awakenings where I had really come fully awake, and decided I might as well use the bathroom and perhaps read for a while until I grew sleepy again.

It suddenly occurred to me—and looking back on the event it was as if the Lord whispered to me—that now would be a good time to search for the cause of the perplexing sound.

I did use the bathroom, then took my flashlight and my tools and crept slowly up the stairs. Though I felt silly doing it, I even avoided the creaky

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boards, just in case some spirit, human or otherwise, might be listening. The brief trip to the narrow staircase was also done silently, but I knew there was no way I could do the same going up those stairs.

I set the flashlight upright on its tail end for illumination, then fairly charged up those stairs, screwdriver and hammer in hand. With a few swift strokes and a little prying the locking boards fell off and I flung open the door.

It was pitch dark in there, but I heard scurrying and swift scampering, hisses and meows. I recalled there was a light switch just inside the room, and with a quick prayer that the bulb was still working and that time or rats hadn't damaged the wires, I flipped it on.

It worked. Light flooded the room. The secret was revealed.

The room was full of kittens. Or runt cats, maybe, just like Snowball. They were all clustered in the corners except for a few that dove down through the hole to the storage room below. They were of a multiplicity of colors; black, white, orange, striped. But none were larger than a several-month-old kitten.

And they were all *looking* at me.

Then my Snowball separated himself from the others and came before me. He sat down and stared at me, and uttered a plaintive meow. He got up again and bumped my leg with his head. I picked him up. He purred loudly. "Just what am I going to do about this, Snowball?" I asked him.

He purred some more, and then I heard them all purring, a soft, resonant hum that soothed and brought contentment.

"Enough already," I said. "I can't think of doing anything with you until the snow is cleared out anyway." They purred even louder. I tried to count the cats, but I was beyond three dozen and getting confused about which I'd already counted when I gave up. There were more than fifty but less than a hundred.

I closed the door to the room and carried Snowball downstairs with me. "My, my, little friend. So that was the secret you were keeping. Well, you and your friends did a mighty good job of hiding. It was just a fluke that I caught you tonight."

I carried Snowball into the kitchen with me, then put him down next to his litter box (which I'd fashioned from a shallow desk drawer and unused potting soil the night of his arrival).

Then it hit me. At the risk of sounding indelicate, I suddenly realized that the room with all the kittens in it didn't *stink*. I had noticed no cat feces nor smelled the pungent aroma of stale urine which one should have expected.

Hmmm. This was even a bigger mystery.

Even with Snowball at the foot of my bed, I failed to sleep anymore that night.

The next day I came to a decision. Snowball was not on the bed, but he was sitting in the chair next to the nightstand, staring at me, almost as if he was taking my measure. So even though it was silly, I told him what I'd sorted out.

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"Snowball, it's clear to me that you and those other kitties are no ordinary cats. I don't know where you came from or what you're about, but you don't seem to be causing any trouble, and you all seem smart enough to go outside to take care of your, er, personal hygiene requirements. I can't feed you all, but you don't seem to need me for that anyhow. So you and the other cats can stay in the church unless or until you become a problem, OK? Lord knows, and I mean that literally, what your purpose is here, but you've got free rent until you do something to make me change my mind."

Silly? Of course. But Snowball understood and then he left me for a time, perhaps to run off to tell the others of my decision. Who could say?

The next few days went by without a problem, although it continued to snow and another blizzard was about to blow through. From time to time I'd see one of the other cats going about, but they always seemed to be busy.

On the day of December 30 I saw a news report concerning the disappearance of dogs, both pets and strays, since the start of the bad weather. I had a pretty good idea now of who was behind *that.*

And on New Year's Eve the stranger arrived.

The morning of New Year's Eve had been a pretty one, with a bright sunrise bejeweling the frosty countryside. But by late afternoon the clouds had built up again and the wind had come ahowling, and a blizzard was again upon us as the last of the daylight began to fade.

I was out looking into the teeth of the wind when I heard the gunshot.

I'd been on the porch with Snowball because we were both concerned about Frisky. Frisky seemed to be Snowball's special friend. But she had not returned after going outside that afternoon, and I wondered if she'd gotten caught in the storm.

But immediately following the gunshot, I saw the little tiger-striped Frisky come racing across the yard, as best she could in the deep snow, and she shot into the house as if propelled from the gun itself.

Now what was someone doing out there hunting in the storm?

"Hello!" I hollered into the wind and the waning light. "Hello!"

"Where's that (blankity-blank) vermin?" came the reply, but even that short sentence consisted of huffing and puffing, and hinted at near derangement. "Where are you?" he called again, only this time I felt that the yell was aimed at me.

"At the church!"

"What church? Where am I? I can't see!"

"I'll have to get him," I turned to say to Snowball, but he had returned inside. Though I had been suitably outfitted to stand on the porch in the cold, I required more gear to go out to retrieve the stranger. I hunted down my boots and put on my heavy coat, then wisely took the roll of twine from the broom closet and tied one end to the porch rail.

It was hard going as I slowly un-

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rolled the twine and walked out into the storm. After only a few yards, I too could no longer see the church, and my hopes of finding the stranger were nil. Unless. . . .

"Fire your weapon into the sky! I can't find you!"

A sharp report went off no more than ten feet to my left, and in moments I found the stranger. He was lying on his back, his teeth chattering uncontrollably. I fairly lifted him off the ground, immodestly congratulating myself on my strength, and helped him back to the church and into my living room.

The gun I left out in the cold.

I had a roaring fire going and a large mug of hot chocolate in the stranger's hand before I tried to ask him any questions. Strangely, all of the cats, even Snowball, had seemed to go into hiding, for I had seen not one since the stranger had arrived.

"I'm Reverend Dawson. What is your name?" I asked. "And what were you hunting in such a frightful storm?"

"My name is Jeff," he said. "And I was hunting the most frightening animal that men have ever faced. An animal that I created. I have to kill them." He was talking to me and yet not talking to me, as if this were some mantra he had told himself over and over again.

"Something you created? Would you care to elaborate?"

He told me an amazing story.

He had been a bioengineer, and he had been trying to create a species of cat that would remain small and cute like a kitten for years. In this he had been successful, except that he'd forgotten that mammals go through a stage of exceptional learning ability when they are young, and his kittens were permanently locked into that stage until they finally grew up near the end of their days, bred, and died.

"The first was named 'Puff.' Brilliant cat. Had a run-in with a vicious neighborhood dog that had even once attacked my daughter. I'd never been able to kill the dog myself. He built a trap out in the woods with a carving knife from the kitchen and a clever snare. But he used my daughter to bait the trap, lured her out into the woods when he knew the dog was out there."

That had been some years ago, I discovered. Since then Puff had bred with other cats, and now they had multiplied to Lord only knew what numbers.

Despite the nature of the story, I didn't tell him about Snowball and the others.

"And you have been hunting these cats ever since?"

"Yes. I found a whole slew of them holed up in a warehouse not far from here. I burned the place to the ground. But somehow they escaped—I was only able to find a few bodies."

So that explained the advent of Snowball. They'd been fleeing a warehouse fire *set by this man.*

The phone rang. I excused myself and went to answer in the kitchen. It was my son, calling from Australia to wish his father a happy new year. We talked briefly, but joyfully, and I wished him luck in his quest. Then I wondered about my visitor. What was

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his family doing tonight? Where was this daughter he had been so eager to protect, at *this* moment?

And then I noticed that the silverware drawer was ajar. I opened it fully. All of the knives were gone.

I hurried back out of the kitchen. Fortunately, Jeff was all right. I resettled myself but I kept an eye out for the cats. "So where is your family tonight, Jeff?"

"Home. At least I think so. My wife divorced me a few years ago."

"Your daughter?"

"My wife got custody. I try to see her when I can." He slumped noticeably into the chair.

I thought about Snowball, and how he had behaved around me, and how he had been watching out for the other cats when he'd led them here.

I thought about the missing knives.

"Jeff, why do you think Puff killed that dog? Couldn't he have just run away? You said you never saw Puff again after he killed the dog anyway."

"He hated that dog. He would have done anything to kill it."

"You tried to kill the dog, too."

"It attacked my daughter! I loved . . . *love* my daughter." He seemed on the verge of tears.

"Maybe that was Puff's motive, too."

And then he did cry, for his lost life, the lost years, and his lost family. I let him get it out of his system. I noticed Snowball standing by the kitchen door, watching.

Presently, Jeff said, "I'm afraid of them, Reverend. They're smarter than us, I think. They're learning too much. I'm afraid they could take the world away from us."

"How many of the cats do you think there are now?" I asked.

"I calculated it once. Could be thousands by now."

"And you think you can get them all?"

"I have to," he said desperately. "I created them!"

"So you did," I said. "From what you say I'm not convinced they are the danger that you claim. But there are now more than you can ever hope to rein in yourself. That's the Lord trying to tell you that they're no longer your responsibility. They're His. Like it or not, Jeff, they have their own destiny now."

"No," he said. "No."

"Go home to your wife and daughter. It's New Year's Eve. Why are you with me and not with them?"

"No," he said again, weakly. "No." But soon out of distress and exhaustion, he fell asleep.

I put another blanket around him and decided to sit up the rest of the night, maintaining a vigil lest Snowball seek to do him harm. My little friend had left the kitchen by that time. But though the spirit was willing, the flesh was weak, and I fell asleep.

I awoke with a start, sunshine was pouring through the window. Jeff was gone, but he'd left a note with a thank you, both for the treatment and the conversation.

And all of the knives were back in the drawer.

It's been a year now since the stranger was here. I sometimes won-

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der about him and his lonely battle against the cats. He hasn't come back this way since then. Maybe he did go home. It's just as well because I've had no reason to regret my decision nor my deception in not telling him about Snowball and the others.

By the following spring, an odd thing happened to Snowball, Frisky, and those others that I had always thought of as the "leaders"—they grew up. By summer I had a dozen adult cats running around the church, but they continued to act as they always had, and they continued to lead the others.

They also started to procreate.

By the fall the back rooms and hallways of my church were filled with adult cats, adult kittens, and genuine kittens. Of these last, I've grown particularly fond of those sired by Snowball with the help of Frisky, and even now as I write this memoir they are playing amongst my things, except for one who has taken up position atop my computer monitor, and looks liked he'll sleep there until the second coming.

It is once again New Year's Eve and I have spent the entire evening composing this story. I had not seen the need to do so before today, but this morning something happened to put me in the mind to record the details. I do not know what the future will bring for this new race of cats, but in a small way I, too, am now partly responsible for their eventual destiny.

You see, after breakfast I went upstairs to the tower room because I recalled there was a trouble light stored away up there and I had need of it. I opened the door to the storage room and stopped.

Upon each of the desks, still in neat rows, sat attentively one of the new kittens. Snowball and Frisky were at the front of the room. I saw that the trouble light was already in use because it was lit and carefully positioned near Snowball. Snowball himself had a willow switch in his mouth, at the end of which was a marshmallow, and he was dangling it over the lamp as if roasting it in a fire.

When I'd opened the door, every kitten head in the room turned toward me. Frisky seemed amused. Snowball seemed annoyed. I muttered an "excuse me" and swiftly closed the door.

I used to teach Sunday school in that room, two sections.

I know a class in session when I see one. ■

Editor's Note: This story is a sequel to "Puff" (Mid-December 1993) and "Fluffy" (June 1996).

Genetic storage is a nuance of evolution too often ignored.
—Robert T. Bakker

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THE ANALYTICAL LABORATORY

Illustration by Anthony Bari

Once again we'd like to thank all who voted in our annual poll on the previous year's issues—your most meaningful way to convey appreciation and positive reinforcement to the authors and artists who do an especially good job of entertaining you. Your votes help *you* by giving us a better feel for what you like and don't like—which helps us know what to offer you in the future. They help your favorite writers and artists by rewarding them directly and concretely for outstanding work.

We have five categories: novellas, novelettes, short stories, fact articles, and covers. In each category, we asked you to list your three favorite items, in descending order of preference. Each first place vote counts as three points, second place two, and third place one. The total number of points for each item is divided by the maximum it *could* have received (if everyone had ranked it #1) and multiplied by 10. The result is the score listed below, on a scale of 0 (nobody voted for it) to 10 (everybody ranked it first). In practice, scores run lower in categories with many entries than in those with only a few. For comparison, the number in parentheses at the head of each category is the score every item would have received had all been equally popular.

NOVELLAS (2.50)

1. "Fish Tank," Gregory Bennett 4.16
2. "In Forests Afloat Upon the Sea," Daniel Hatch 2.53
3. "The Human Animal," Julia Ecklar 2.40
4. "Touchdown, Touchdown, Rah, Rah, Rah!," W. R. Thompson 2.34
5. "The Secret Life of Gods," Maya Kaathryn Bohnhoff 2.06

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NOVELETTES (0.80)

1. "A Portrait of My Grandfather," Doug Larsen 2.92
2. "Capra's Keyhole," Stephen L. Burns 2.24
3. "Unfinished Symphony," Rick Cook & Peter L. Manly 1.97
4. "Down Under Crater Billy," Stephen L. Burns 1.35
5. "The Good Rat," Allen Steele 1.09

SHORT STORIES (0.60)

1. "TeleAbsence," Michael A. Burstein 2.76
2. "Kath in Winter," Marc Stiegler 1.38
3. "Walking the Virtch," J. Steven York 1.28
4. "The Dream of Houses," Wil McCarthy 1.03
5. "The Void," Michael McCollum 1.00

FACT ARTICLES (1.42)

1. "A Handful of Heresies," Charles Sheffield 2.61
2. "Fact-Free Science," James Hogan 2.58
3. "The Martian Frontier," Robert M. Zubrin 2.32
4. "Faster-Than-Light," Dr. Robert L. Forward 1.56
5. Tie: "Black Horse: One Stop to Orbit," Robert M. Zubrin & Mitchell Burnside Clapp 1.53
   "The Artemis Project: Selling the Moon," Gregory Bennett 1.53

COVERS (1.54)

1. Mid-December "Unfinished Symphony": Bruce Jensen 3.03
2. January "Tide of Stars": Bob Eggleton 2.97
3. March "Renascence": George H. Krauter 2.34
4. July "Final Review": Jim Burns 2.04
5. Tie: April "The Human Animal": Peter Peebles 1.38
   June "Black Horse: One Stop to Orbit": Ron Fleming 1.38

Two categories this year had real "standout" winners, dramatically ahead of all the competition: Gregory Bennett's novella "Fish Tank" and the short story "TeleAbsence," by Michael A. Burstein (a new writer!). Each of those was followed by several "neck-and-neck" runners-up, while competition was tight at the top among covers. We had two fifth-place ties and two authors (Stephen L. Burns and Robert Zubrin) who placed twice among the top five items in one category. Julia Ecklar seems to have suffered slightly, but only slightly, from being up against a tough competitor: herself. Both of her "Noah's Ark" stories, "The Human Animal" and "Tide of Stars," placed quite highly among the novellas, but readers couldn't quite agree on which to rank higher.

David E. Stone of **Longmont, CO** is this year's winner of a free one-year subscription in a random drawing from all ballots received. Next year that could be you—and the more votes we have, the more the results mean!

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Joseph H. Delaney

PARTNERS

Humanity has never really been alone in the Universe, and if things had been just a bit different. . . .

Illustration by Dell Harris

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Alice Simmons emerged from the kitchen door, wiping her hands on her apron. Her day had been busy. It had started at dawn, and now, at mid-morning, she felt the need of a break.

She stepped out into the Sun, which blazed hot already. The air felt damp, not quite humid enough to be called muggy, but close. It held a definite promise of afternoon showers.

Soon Mel, who had left home on his tractor before sunup, would be coming in from the cornfield to eat his lunch. Alice had been keeping watch on the grape arbor, her project, part of the garden which is every farm wife's private fief, and she knew that some of the bunches were already making sugar and tasted sweet and juicy.

Upon that thought she retreated momentarily into her kitchen, found her shears and hustled off to pick some of the fruit to go with their lunch.

Her objective was the sunward side of the arbor, the final row, where the light was unobstructed and mother nature had been pampering the vines since the first thaw. She made for that like a bee after honeysuckle.

There they were, dusty blue, plump and heavy, already drooping against the inexorable cling of gravity as far as their stems would allow them. Alice was pleased to see no signs of rot, or of bird predation, which had so badly mauled last year's crop.

She brought no basket. She would take only a couple of bunches, just what they needed for lunch, no more than a double handful. She searched out the ripest bunch and reached a hand under to support it while she cut the stem.

That was when she saw IT!

IT slithered away from her.

Alice screamed, and recoiled, drawing back against one of the arbor posts, which, rotten at the base, would not support her weight. It promptly broke and dumped her backward across the trailing vines. Alice screamed again.

The creature seemed to have heard. It glared at her for a moment but did not appear to be alarmed. It turned complacently back to its feeding, seized another grape in its jaws, pulled until the stem came out and strained to swallow it.

Alice struggled to her feet, outraged at its brazen behavior. She still wasn't quite sure what kind it was, or whether it was poisonous, but there was no doubt in her mind that this was a snake. And Alice, like most people, was not particularly tolerant of serpents of any kind.

Her thoughts immediately turned from flight to defense, and from there she began to contemplate offensive possibilities. Alice resolved she would not be intimidated, she would not be robbed. She would arm herself and she would fight for what was hers.

She ran to the barn, where her gardening tools hung on a rack behind a creaky, immobile door that Mel kept promising to fix but never had. She selected a well-worn hoe, although its handle was cracked and bound with friction tape that made her hands black when she used it, was nevertheless clean and shiny and

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sharp where it counted.

Armed thus, she ran back to the arbor, creating enough disturbance to wake up the dog, Brutus, an old and mostly deaf beagle, who then followed along.

The snake was still calmly eating grapes when she got back, and seemed not to fear Alice armed and vengeful any more than it had feared Alice in flight—not until she took her first swing.

Then it fled, her swing having missed so narrowly that the breeze it made blew something off the creature.

In an instant the snake was gone, its pale white and curiously undulating form wiggling first along a thick vine and then dropping to the ground, where it retreated rapidly in a sort of combination scurry and slither.

Brutus caught a scent, but he didn't seem to know what to do with it. It was as if it simply failed to excite him. He looked bored.

Alice tried to sic him on the creature, as she might have done to any other varmint, but unlike rabbits, which Brutus loved to chase in his own peculiarly leisurely way, this creature was clearly not prey to him.

With disgust, and promising herself that she would catch the creature later, when it got hungry and returned, Alice picked what ripe grapes the creature had left and took them in the house. She left the hoe on the porch, ready for instant use.

"Alice, I'm ashamed of you. You're a farmer's daughter and a farmer's wife. You know snakes only eat meat. There aren't any vegetarian snakes."

"I only called it a snake because it looked like one, even if it was snow white and had these." She held up a tiny object.

Mel leaned over to study it. "Feathers? It had feathers?"

"I guess so. I saw this one fall off when I swung my hoe at it."

"Looks like a chicken feather to me," Mel shrugged.

"The chickens are all penned up. None of them have been loose for weeks. . . ."

"Maybe Big George lost it, or somebody's stray, or maybe it came off a wild bird, like a pigeon. The barn's always full of them even with those owls hanging out in there."

"You don't believe me?"

"I never said that. I said as far as I know snakes don't eat grapes or have feathers. I don't doubt you saw something, but—"

"Then I'll catch it, or I'll kill it, one or the other, but I won't let it gobble up my grapes and I won't let you tell me I'm losing my grip." Alice stood and went to the sink to do the lunch dishes. She turned her back on Mel and wouldn't look at him even though he hugged her from behind and tickled her neck with his mustache, something that always got her going when she wasn't sore at him.

"I'm serious, Mel. Now, why don't you get on your kiddie car and ride off into the sunset before my imaginary snake decides to crunch your corn crop?"

Mel was not a fighter. He was, however, a pretty good farmer and he knew Alice was right—if he didn't fin-

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ish the spraying he'd have all kinds of beasties living off his toil.

"I'll see you later," he said, giving her a chaste peck. "Be careful, will you? Just because that snake of yours is a vegetarian doesn't mean he won't bite." Mel waddled off in his clunky boots, leaving Alice with a sobering thought; what if it did bite—and what if it was venomous?

Three days passed. Alice and Mel had pretty much made up, and both were smart enough to keep quiet about Alice's experience. Mel never had believed that what she had seen was a snake and she was herself beginning to concede the possibility of mistaken identity.

Nevertheless, Alice kept a close watch on her garden, particularly the grape arbor, and never went anyplace without her hoe. She also prepared a forked stick, which she kept handy, though out of sight, because unlike the hoe the stick was something whose purpose Mel would guess immediately. He wouldn't approve of such intimacy with a wild animal.

She could kill the snake with the hoe, of course, but the stick's noose of baling wire might enable her to take it alive. She wasn't about to try handling it bare-handed, but if the noose worked she could drop it into the big thirty gallon trash can she was reserving especially for that purpose and prove to her stubborn husband that she wasn't just seeing things.

But, no sooner had she prepared herself to do battle with the snake than she discovered she was armed against the wrong enemy. Another, even stranger varmint appeared, a cloud of ravenous little creatures that crept across the ground with frenetic speed and behaved like a school of fish or a flock of swallows. It moved as one. It started and stopped in unison. When one turned they all turned, and the final turn they made was straight into Alice's lettuce patch.

The "flock," silent as a shadow and almost as quick, swarmed over three rows on one corner, and Alice was horrified to see that it operated almost like a buzz saw. Whatever these creatures were, they were behaving just like the leaf-cutting ants Alice remembered from the National Geographic programs on TV. The only difference was they didn't carry the leaves off, but consumed them on the spot. Greenery was disappearing with alarming speed, and these soft brown lumps were reappearing in its place.

Alice didn't have any idea what they were. Like the snake, they were new to her experience and she didn't know what to do about them. Certainly, there were far too many for her to simply stomp, and they were pretty clearly not insects, so even if she'd had insecticide prepared it might not bother them.

Fortunately, in a genuine flash of genius Alice realized she had allies, a whole yard full of them, her chickens. She wouldn't have to fight alone this time.

She raced to the chicken house, which formed a part of their pen, and frantically grabbed a scoop of grain with which to lay a trail to the lettuce patch.

With this bait, she opened the gate

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and let the flock follow her. She ran out of grain just before they reached the creatures, who had by now penetrated into the center of the patch. Fortunately, chickens are dumb and they didn't know that, and so they followed her in the expectation that she would throw them some more grain.

They got a better treat. They loved it. Once the first chicken spotted the first "bug" and sampled it, there was no stopping them. Greedy for more, the dominant hen took over, leading the assault deep into the plot where the birds quickly surrounded and exterminated the invaders.

Alice could not find one survivor. She still didn't know what they were, and under present circumstances didn't have a prayer of capturing a sample. Worse, her saviors now began to turn on her. Some were still hungry and eager to forage, so Alice had to get them back into their pen before they gobbled up what was left of the lettuce. Some of them really liked lettuce.

The task took nearly half an hour. When the job was finally done Alice surveyed the damage. One whole corner of her lettuce patch was now utterly bare, the plants clipped off at the ground. Half of what was left was trampled or badly pecked. Mel was certain to notice that, and ask what happened, so Alice decided she had finally had enough of his skepticism. She knew there was one way to get a sample before he got home, though it would be dead, not living.

"What's this? Chicken on Tuesday? Chicken's for Sunday, Alice."

"That's not chicken, Mel, that's crow."

"It is, huh? What's got you riled up now, Alice? Has your snake been back?"

"Something worse, Mel. Go look in the freezer."

"Look in the freezer? For what?"

"There's a coffee can in there with something in it that I think you should see. Go get it."

Puzzled, Mel did. When he returned he had the lid off and was poking around inside with the point of his pocket knife. "Alice," he said grimly, "I know this is a chicken crop—on the outside—but what are these things inside?"

"Figments, Mel. Imaginary varmints, like that snake I didn't see. Mel, didn't you notice the lettuce patch? You walked right past it to get from the barn to the house. Didn't you see anything strange?"

"Yeah. I did. Why'd you pick so much lettuce? Who's gonna' eat it all?"

Alice exploded. At times Mel could be very obtuse, and the only way to get him out of it was to use brute force. "Those 'figments' ate it already, Mel," she shrieked, "and if it hadn't been for the chickens I'd have lost it all!"

Mel still looked puzzled. He was covering his ears.

Alice changed her tack. "Mel, aren't you listening? I said these little varmints just swarmed in and started eating, like locusts—well, maybe even worse than locusts, because they're faster and bigger and they can eat more. They picked all that ground clean in less than five minutes. Mel, what's going to happen to us if they start on the cash crops?"

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Now, it registered. Mel understood. He stepped over and gave Alice a hug, and said he was sorry.

But Alice still wasn't pacified. "Something strange is happening here, Mel, and I think it's time for us to tell somebody on the outside about it. I don't know what those things are and you don't know what they are, but I've seen what they can do and we both know that if they're anything at all like locusts it'll take more than our chickens to stop them if they decide to come back."

"You're right," Mel answered somberly. "I'll call Eddie and ask him to come over."

Alice cringed. She didn't particularly like Eddie Whitman. Eddie had once been a suitor, back in high school, and he never had married. He was the community's most eligible bachelor and he seemed to want to stay that way. He liked to hit on the married women and avoided the single ones.

Alice knew she would have to endure his visit and his attention. Eddie was the county agricultural agent, and she had to admit, though grudgingly, that in his own line of work Eddie did possess a few smarts. "I just hope we'll be able to get rid of him at a reasonable hour," she sighed.

"They're not insects, Mel. They have only four legs. Also, this hair, if that's what it is, means they're mammals, because only mammals have fur. But whatever they are they're an entirely new species, and the smallest yet. None of these is bigger than a junebug. Even shrews are bigger than that, at least the kind we have around here.

"No," Whitman grunted, after a short, but thoughtful pause, "this is definitely a new one on me. Maybe the boys at the state ag lab will know what they are, but I can't identify them."

"You can keep the sample, Eddie," Alice said. She had been silent for some time, thinking, letting the men talk, letting Mel get himself solidly impaled on the hook. "Ask Mel to tell you about my imaginary snake, Eddie."

Mel's look was pure terror. He knew Eddie's character pretty well, and he knew Alice was baiting him. The tactic was a familiar one from the old days, the wily female pitting the males against each other.

Since Eddie was more than ordinarily susceptible to such manipulation, he bit on it this time, too. "Snake, you say? What kind of snake would this be, Alice?"

"White, Eddie, snow white. And it was uppity. It sat there eating grapes like it owned my arbor."

"Aw, come on, Alice, snakes don't eat grapes."

"Nor do they have feathers—ordinarily," Alice replied, putting some English on the word "ordinarily," mostly for Mel's benefit. "This one, however, was exceptional. Here's the feather. You can send that to your state lab too, if you like." She paused, and glared at Mel before turning back toward Eddie to finish her remarks. "I will admit I don't know any more than the two of you do, but at least I have sense enough to be scared. I

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think we're going to be seeing more of these creatures and I don't think they're going to be much fun to be around."

Alice rose from her chair. "Now," she announced, "I'm pretty tired of all this. I got up early and it's been a tough day. I'm going upstairs to sleep. You two can talk this out and Mel can let me know in the morning what you've decided to do." She turned and stomped off.

It wasn't long after that Mel came up to bed. Alice's pouting had accomplished one thing, it had gotten rid of Eddie quicker than ever before.

For two days a steady but gentle rain had fallen. Though it was more drizzle than downpour the fields became too soft for Mel to go into with the tractor. Thus, though the storm had passed, he spent the next day close to the house, repairing and servicing his equipment.

Except for the chickens, Brutus, Big George, the gander, and a couple of half wild cats there were no other animals on the place. Time was that Mel and Alice had raised a few hogs and kept a small dairy herd, but they quickly discovered the meager profits weren't worth the effort. The domestic market had been depressed since government subsidies had been abolished. Imported meat was cheaper, and dairy farming was a job for specialists, usually agricultural corporations whose diversified operations enabled them to grab enough market share to compete.

So, thanks to the rain, Mel was close at hand when Alice needed help, as she did when she encountered the snake again.

She had been working near the arbor, reseeding the corner of the devastated lettuce patch and using her hoe to dig furrows. The pattern of strange tracks in the mud of a drying puddle, which she took at first for those of a dung beetle, alarmed her as soon as she realized these had toes, which insects lacked. The toes were in a birdlike pattern, three pointing ahead, and one backward.

She didn't connect these with the snake until she glanced ahead and saw the snake crawling up one of the posts toward the grapes. Clearly, these were its tracks.

Mel came running over in response to her call, and when he arrived she said nothing, she simply pointed.

"It *was* real," he gasped. "And," he added, "he really doesn't seem to care much that we're watching him."

"I told you he was uppity, Mel. Here, take the hoe. Watch him until I get back with my snare. This time, I'm going to get him."

Mel took the hoe, knowing from experience that if he didn't go along with Alice's plan it would be a long while before he heard the end of it. Besides, her plan was a good one, provided . . . Mel suddenly realized the snake's uppity attitude might be justifiable confidence.

After all, it suddenly dawned on him, that's exactly the same smug attitude you find in the average skunk. The biggest danger a skunk faces is getting smacked by an eighteen-wheeler—because skunks are so used to things running away from them

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that they just can't imagine an enemy that stands its ground.

Proof of that was the thousands who annually strolled out onto highways to feast on road kills and who never made it back to the shoulder.

Alice returned with her stick, prepared to move in on the snake.

Mel stopped her. "Wait a minute," he said, "something about this thing bothers me. Since he isn't in any rush to leave let's not take any chances, let's get some more firepower." He reached out for the stick. "Let me hold that. You run inside and get my twelve-gauge pump."

"That'll pulverize it, Mel—"

"And that, Alice, is the general idea. If it gets away from me or looks like it might strike you can pulp it, OK?"

Alice nodded, and decided Mel was right. Besides, it sounded to her that he planned to let her do any shooting that might be necessary. She wouldn't kill the snake if she could help it.

A moment later she was back, shotgun in one hand, bandolier in the other. She found it was fully loaded, so she hung the bandolier over her shoulder. "I'm ready, Mel, anytime you are."

"I'm waiting until he starts to gobble another grape," Mel answered. "It'll be hard for him to bite anybody with a grape stuck in his throat. There he goes—now!"

Mel lunged. The fork of the stick caught the creature by surprise but it didn't quite pin him to the post. He slipped loose and dropped to the ground, simultaneously coughing up the grape.

It started toward Mel, though not with any deliberate speed. It looked almost like it was expecting Mel to flee. When he didn't, the snake stopped, and that was when Mel pounced again.

This time Mel's aim was better and he could shove the points of the fork deep into the soft dirt. As he did so, drawing the noose tight and immobilizing the head, the snake coiled the rest of its body around the end of the stick.

"Look out, Mel," Alice screamed, training the shotgun on the snake. "Mel, it's not the head that's dangerous, it doesn't bite, it stings, like a wasp." She pointed to a couple of glistening amber beads on the dull colored stick. "Those have to be poison. Get back, I'll blast it."

"No, Alice! Just keep it covered. I think I can manage." Mel took the hoe in his other hand and used it to pin the tail to the ground. He held it in such a way that by bearing down he could have cut the tail section and the sting off if the snake tried to free itself.

Then, he manipulated the noose in front of the head and slipped it over. The snake did not seem to care. It did not resist, but instead concentrated on trying to free its tail.

"I got it, Alice."

"I think we should kill it, Mel. It's too dangerous."

"Nothing doing, Alice. Come on, let's get to the can, then you can run inside and call Eddie."

"The can might not hold it, Mel."

"I'm going to keep the noose on it too, Alice. Now go, I'll be fine."

Alice made the call and rejoined Mel outside, clutching the shotgun

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like a rag doll. She was already beginning to regret not using it.

In a few more minutes they heard a siren. It was the sheriff, whose office was across the hall from Eddie's. The squad car came roaring up into the driveway and screeched to a halt, scaring the pants off Brutus in the process, even though he wasn't wearing any.

Eddie literally tumbled out of the back seat. He was followed an instant later by Jake Fletcher, who was generally regarded as the county's most experienced snake handler. "You got him, huh?" Jake exclaimed as he approached. "Guess there's nothing for me to do unless you've got some more."

"Believe me, Jake," Alice answered, "this one's enough. We're pretty sure it isn't a snake, though, and that it stings instead of biting." She paused, realized that might not be so, and added, "At least we've seen it stinging—it might bite too, but—"

"That's no snake, Alice," Jake replied.

"Or anything like a snake," Eddie added, "except in the way it's shaped. It's warmblooded, and it's got legs, and it'd be my guess that it's almost blind."

"How do you know that?"

"Those feathers are to keep it warm. Cold-blooded animals don't have them, and they'd be a distinct disadvantage because they'd make it harder for the animal to warm up to active state. They'd block out sunlight, and insulate the body underneath so it'd stay cool.

"I'd bet it's a burrower, at least for most of the time, though it clearly doesn't hesitate to come out and forage. Its shape, and those little feet would make it easy to get around in tunnels. Underground, where eyes are next to useless, they generally atrophy—and, there's a sort of horny shield above the thing's snout that would make a pretty good spade.

"The creature probably prefers soft ground, maybe only a few inches below the surface, making tunnels something like what moles live in. Since it's a vegetarian the sting is probably for defense only, but even so, it'd be my guess the venom's uncommonly potent. I can't wait to get a sample."

"Here you are," Mel said, handing the stick to Eddie. "There's some of it drying right down there." He pointed to the two amber blobs on the shaft.

Eddie turned to Jake. "What do you think? Is it safe to drop him in the can?"

"I don't think I would, Eddie. Tell you what, let's get some cord and lash him to the pole, *then* put him in the can. That way we can open it again later without having to fight it off."

They followed Jake's advice. A couple of minutes later, as Mel and Alice watched the squad car drive away they both suddenly realized this wasn't the end, that life on the farm would get a whole lot more complicated than it had ever been before.

Bedlam followed. Not only did the state ag people get into the act, so did Uncle Sam. The U.S. Department of Agriculture sent a whole platoon of eggheads out for a look. They got in

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Mel's way, often forbidding him to enter onto parts of his own farm. Mel took to carrying the twelve-gauge around with him. That improved their attitudes but they were just as firm.

After about a week of this the restrictions were relaxed a bit. Mel had no more difficulty getting around in the outlying fields and the official investigation became concentrated on the area around the house, which was the only place where any of the strange creatures had been seen.

By now, everybody in the immediate neighborhood knew there was something wrong at the Simmons place even if they didn't know precisely what. The Simmons's credited that to Eddie, of course, but even Eddie was smart enough not to let things get out of hand. Too much talk, even he realized, could get the sensational press aroused.

"Looks like we not only have two new species to name," he told Mel proudly, "but two different genera, probably a new class and maybe even a new phylum. There are lots of similarities with our familiar animals but they seem to be caused by adaptation to similar ecological conditions instead of biological relationships.

"That 'snake' for instance, is really more comparable to a lizard, except that it's vegetarian, and in that respect resembles a gopher. But then, only arthropods have so many legs, and only avians have feathers."

"I don't know what half the stuff you're talking about is," Mel confessed.

Alice, who was sitting there quietly listening, suspected that it was probably Eddie's intention to make Mel look dumb in front of her. Still, and because she knew Mel wouldn't take offense, she wanted to satisfy her own curiosity. "Just what do the experts think these things are, Eddie?"

"The 'experts' are baffled, Alice. Those little ones, for instance, are not anything like mammals despite the hairlike growth, which is not true hair but modified feathers. We found what we think are fertile eggs in some of them but haven't had any luck yet in hatching anything.

"The snake? Well, the snake doesn't seem to have any recognizable reproductive system at all. We probably won't be able to tell whether it's male or female until we catch another one. We have been able to analyze the venom, which is unlike anything else we know of. It's a protein, of course, but that's the only similarity it shares with the usual animal toxins. Otherwise it's different from anything else we've ever seen. We're still studying tissue samples from both species and they promise to be bizarre."

"Does that mean the poison wouldn't hurt us?"

"Definitely not, Alice. In fact, it should cause a really horrendous immune reaction. If you ever get near another one be careful, the bite would probably be just as bad as a sting if any of its saliva got into the wound."

"Where did they come from?"

"From off your farm, Alice." Eddie shrugged. "That's the only answer I can give you. Nobody else has seen any."

Alice and Mel had to be satisfied

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with that explanation. It never got any better. As time wore on and nothing else happened the eggheads packed up and left, to do what eggheads do best, refine their understanding of things already familiar. To them, these incidents were an interesting but inexplicable experience that didn't seem likely to be repeated anytime soon. If it was, they promised to return.

Mel and Alice reverted to habit as well. Mel got the corn in shape just in time to harvest their wheat, after which it was time to concentrate on the soybeans. Their strange visitors began losing their reality, becoming more myth than memory—until one night in late October, Halloween arrived slightly ahead of schedule.

Something was wrong outside. Mel was awakened by the foghorn honking of Big George, the gander. From the sound of it George was in some kind of fight.

Mel slid out of bed, just as Alice began to stir.

He had been keeping his twelve-gauge, boots, and a heavy robe by the bed ever since the government people left, and had stashed other weapons at strategic places around the house. A big five-celled flashlight was taped to the gun barrel, positioned so that its beam would coincide almost exactly with the shot pattern. He slipped into the robe and boots, picked up the gun and started for the door.

"Wait, Mel. I'm coming too." Alice had her own arrangement laid out, though her weapon was a lighter twenty-gauge.

"All right," Mel answered. "But hurry—it sounds like George is in real trouble." Actually, he would feel a lot better with Alice along, not only because he would know where she was, but because he couldn't remember the last time he'd seen her miss.

On the way out they flicked on the extra yard lights, adding to the pool of light from the big fixtures on the poles on either side of the barn.

The noise gave Mel a vector, which he followed to the other side of the barn, where the big elm tree spread out between it and the hen house. He didn't believe what he saw when he got there.

Big George, far too big and heavy to fly, had somehow made it up into the tree. He was struggling to maintain his balance in the lower fork and was obviously anxious to climb as high as he could. His right wing was drooping, as though it might be broken, and blood was dripping off the tips of the big flight feathers. At the sight of the humans he seemed to relax a little and the frantic honking stopped.

Below, on the ground, now glaring at the approaching humans with eyes that glowed greenish-blue in their flashlight beams, was the strangest looking creature either had ever seen.

It was big, more than three times as large as Big George, covered with what looked like stiff, stubby feathers. It was four footed, but the rear legs were much larger than the front. Both sets were armed with long, curved claws. The tail was as long as the body, flexible, and in constant movement, twitching almost like a tiger's.

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There was a spiked ball on the end that looked just like a medieval knight's mace.

The two humans watched the creature for a while in frank disbelief, but the creature soon tired of this and obviously did not like having the beams in its eyes. It dropped its front paws off the tree trunk and faced them, standing on its haunches like a kangaroo, thirty feet away. It held this posture for about fifteen seconds, then its jaws gaped open, baring fearsome teeth, and it leapt.

That was its first, and final, mistake. Two heavy blasts struck it in unison, both at the center of mass, then the twelve-gauge roared again. The creature was blown in two, the top half falling backward and the bottom half, in an involuntary movement, leaping like a decapitated chicken. The body landed off to one side.

Mel approached to take a closer look at this part. Alice headed for the tree, where Big George had resumed his honking.

"Mel, I think he's hurt bad, bleeding a lot. We have to get him to the vet." When she said this she didn't even know how they would get him out of the tree but she was sure of one thing, if Big George died from his wounds it wouldn't be because she hadn't tried to save him.

Alice ran to the barn and got a stepladder, which she propped against the tree. She carefully wiggled a hand under George's feet to support him, then carried him down to the ground. He could walk, and he moved the wing back up to its normal position without apparent difficulty. It couldn't be broken, Alice realized, emitting a sigh of relief.

While Mel checked the rest of the grounds for more of these beasts, Alice took George into the house. Along the way she found Brutus, asleep under the back porch, and brought him inside, too. She couldn't find any of the cats, but reasoned that with their nocturnal adaptations and climbing abilities they would be all right.

There was a worried look on Mel's face even though he reported that everything else seemed to be OK. The chickens weren't making any noise and the door and windows on the hen house were intact. He joined Alice inside the house, where she sat drinking coffee and scratching the two dissimilar heads of her animal companions.

"George seems to be all right, Mel, except for a cut on the inside of his right wing, which seems to have stopped bleeding. I know he'll make a mess but I think he's earned a night in and I'd worry about him if he was outside. I guess we can let the vet sleep. I wish I could. I know I'm going to be awake all night."

"Maybe we can find something to do to keep busy," Mel replied, with a wink.

"Maybe we can," She answered, and shooed the two animals away while gulping the last of her coffee.

The harried couple had gotten little sleep, nevertheless they met the Sun at rising, anxious to study the remains of the devastated creature. They found only its head and a maze of strange tracks, one of which was

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clearly the mark of the rest of the body being dragged off.

Mel and Alice, still armed to the teeth and accompanied by Brutus, followed the trail as far as it went, which left them even more perplexed than before.

"It—it just ends, Mel. There're no tracks away from it, except for those we followed here. Do you realize what that means? It means they're still around." Terror washed over Alice's face. "Mel, we can't handle this, we—"

"I know, I know. You're right. I always intended to call Eddie back, but I wanted to check things out myself first. Alice, I don't think they're still here. I think something, their owner, maybe, picked them up."

"Their what?"

"I didn't tell you this last night, Alice. I didn't want to worry you, and frankly, in the excitement I wasn't really sure I'd seen it. Now that all the tracks lead to the same place I guess it was real after all. I. . . ."

"What, Mel? What was real?"

Mel cringed. "Just—just a light, Alice. A kind of dim one at that. It was a long way off from where I was. I thought maybe I just imagined it. . . ."

"You said, 'their owner.' Mel, what else did you see?"

"Nothing, Alice. Nobody. I didn't see anything but this faint light."

Alice had been around a bit herself, and knew a little something about tracking. She took another look at the jumble of tracks on the ground. Nothing she could see suggested a vehicle had been here. Even a helicopter, had it landed, would have left some sign. She finished her examination and gazed up at Mel. "Mel, either there's some other explanation or these things took off and flew away. And I don't remember seeing any wings on the one that attacked George."

"I don't know what to tell you, Alice. I don't know what I'm going to tell Eddie, and the rest of them, either."

"We tell them these things are dangerous, Mel," Alice answered. "We do the neighborly thing and warn our friends so they don't get hurt."

Mel glanced back, contritely, and answered, "Yeh, Alice, I guess we do. Come on, let's break the news." He took her arm and walked her back to the house.

"Well," Sheriff George Shuler sighed, "The head'll be enough to convince any sober person I know that you're serious. And, then there's the tracks, and these'll probably tell us a whole lot more even than the head will. I've sent for Aberg."

"Who's he?"

"The world's leading expert on fossil footprints, according to the people at the university. He's been studying a place over in the west end of the county where a volcano erupted way back when, and wiped out a whole bunch of dinosaurs. I never met him but he's supposed to be the last word on tracks. He ought to be here about lunch time."

"OK," Eddie added, gathering Mel and Alice around him in a huddle. "Uh, there's something I think I ought to tell you."

"Yeah. You know something new, Eddie?"

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"I was going to call yesterday about it, Mel. Something came up, and I didn't get around to it. But, the tissue samples we took? Mel, the tests results came back and they're weird. These creatures—they don't seem to be related to anything else on Earth. I mean they're just—"

"Just what, Eddie? Are you holding out on us?"

"No, no Mel. This gets complicated, but if I had to oversimplify I'd say that none of the animals we've seen could have evolved on Earth. If they had there'd be signs in the fossil record, and there aren't. The chemistry's basically the same but everything else is different."

"Are you trying to tell me these things came from another planet?"

"I'm trying to tell you I don't know, Mel. That had occurred to me, of course, but the theory has its own set of problems, not the least of which is that the aminos are exactly the same ones terrestrial life uses, down to the very last one."

"I don't follow."

"Amino acids, Mel. Aminos are the basic stuff of proteins. There're lots of them, but terrestrial life only uses a small number. You'd expect a few to overlap but chance can't account for what we found. The odds of that happening are—well, astronomical.

"And that means that the simplest explanation is the most plausible—that somehow they're related to everything that evolved here on Earth, that they've been here all the time but somehow we missed them."

Eddie paused and his face started to flush, as though he was embarrassed by his next remark. "Sherlock Holmes, Mel."

"What?"

"Holmes—the detective who always had the answer. He said, 'Once you eliminate the impossible, whatever remains, however improbable, must be the truth.' That is pretty much how orthodox scientific logic works."

Mel stared at Whitman, waiting for an explanation. None came, so he asked, "What is all that supposed to mean?"

"I—I'm not really sure I have an answer, Mel. If this had happened a hundred years ago, or even fifty I might have bought it, because even that late in history there were still places on this planet that were complete mysteries to science.

"What if they haven't been here all along, Mel? What if somebody brought them, just now, millions of years after the animals we're used to evolved here on Earth? What if in the beginning all life had a common origin?

"There's an old theory, called panspermia, which assumes that life originated in space, even before any planetary bodies were formed, that there are primitive organisms that drift around, dormant, until natural processes move them into environments where they can evolve into more complicated forms.

"The trouble with panspermia is it could only explain the chemical similarity, not the physical similarities—and there are some of these that chance can't account for. There is another possibility that could account for this—that Earth was visited by

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aliens, who brought these creatures along and left them here. In that scenario the most troubling mystery would be, why?"

Mel's face was sober, but he said nothing, he just stared at Eddie.

Whitman felt very awkward, caught as he was without a pat answer. His tone became more aggressive. "Look, Mel, it's not as farfetched as it seems, considering the alternative. I mean, this is the twenty-first century. Except for new insect varieties and an occasional marine species modern science is pretty well out of surprises. We know so much about land animals, even jungle animals, that nobody expects to see anything new.

"But now, suddenly, three totally new creatures pop up in the space of one summer, in a temperate climate that's been crawling with people for the last ten last millennia. The theory is not only tempting, Mel, it's the only one that fits the facts."

"Why would anybody do a thing like that?"

"What?"

"Why," Mel repeated, "would an alien visitor bring animals like these along even if he did come here? One was big and mean, one was poisonous, one ate everything in sight—they were all pests, Eddie."

"Who knows? Crazier things have happened. Here on Earth man has screwed up lots of ecologies by moving animals around, rabbits to Australia, for instance, African bees to South America, sparrows and starlings to North America, walking catfish into Florida, the list is endless.

"As far as the basic pattern of life is concerned, panspermia is one of the oldest ideas in science—that life originated in space, not on planets. It's just as logical to assume it happened once, and spread everywhere matter did, so that primitive organisms rain down on planets as they form, as it is to assume it evolved over and over again on individual worlds."

"So all life has to be related?" Alice had arrived.

"And locked into the same blueprint, Alice," Whitman answered. "Anything that later utilized that blueprint would be very close chemically, but there would be many differences in structural organization. And that," he added, "is precisely what we actually do see here."

"Whoever brought these—" Mel abruptly stopped talking and gawked skyward, eyes searching for the source of the slapping sound of rotor blades which had just become audible.

"That'll be our expert," the sheriff announced as he strode by, heading for the pasture just east of the Simmons farmhouse. "I called the governor, too, and now we'll have some help searching the farm. He promised me enough men to do a thorough job. If there are any more strange critters around we'll find them now. Excuse me, I have to go meet Dr. Aberg."

Once again, there had been a short period of furious activity, government people underfoot everywhere, including, this time, military people. The neighbors got into the act. So did not only the sensational press but the orthodox media. After all, they had one

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live specimen and two dead ones as proof that something out of the ordinary was going on.

The trouble was that nothing was reproducible. No new specimens turned up. Aberg couldn't match any of the tracks to anything that had ever lived on Earth, and the tracks stopped in the middle of nowhere. The military had had no unexplained radar contacts. The several national space agencies all professed their ignorance of any unusual occurrences. The space station, which as a matter self-preservation scanned constantly for vagrant objects in orbit, reported near space was absolutely clear of anything big enough to have transported even a tiny animal to Earth.

Because the creatures couldn't be explained through natural means, even bizarre ones, a new theory evolved, that somebody here on man's home planet was making monsters.

It caught on. After all, the people had been psychologically prepared with a steady stream of monster movies, and everybody knew that there were many who had the skill to do such things.

Geneticists had tamed the killer bees that way. They routinely created food plants that poisoned the insects that preyed on them, and were on the brink of producing animals that could do the same to insect pests. In Africa, two species of tsetse fly were extinct, victims of a virus man had made.

So, the theory had some scientific support. Had there been any obvious wide-spread infestation it might have generated a panic—but being confined, as it was, to the Simmons farm, only they suffered.

The farm had become a shrine to a number of offbeat cults, pseudo-scientists, assorted loonies, publicity hungry eccentrics and other strange beings.

Mel and Alice got used to dealing with crank telephone calls and weird proposals, and to ejecting trespassers from the farm. The sheriff mounted a special patrol on the county road that lead to the Simmons place, which helped a little, and gradually all but the most persistent of the nuts gave up.

Because they felt the need of more security and couldn't afford one of those expensive electronic systems, Alice found Big George a consort. Pretty soon she had a fair-sized flock of geese patrolling the homestead. It meant a lot of nocturnal alarms to investigate, but they both felt this was preferable to more surprises like their last one. Getting past old Brutus would have been easy. Getting past these geese was impossible.

When the really scary aliens came, the trouble was more than worth it.

Alice was home alone when it happened. On this early April morning Mel had driven off on the tractor pulling a planter, to re-sow a forty acre field with late soybeans to replace the crop that had been washed out by rains earlier in the month. But Mel carried a cell phone as well as his twelve-gauge, just in case.

When it rang he throttled down so he could hear better, and the machine barely crawled along. What he heard

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made his blood run cold.

"They're not animals this time, Mel! They're not men, either, and they're carrying spears."

"Stay in the house, Alice, I'm coming. I'm gonna' cut the planter loose and come right in. I'm doing it now, Alice. Don't hang up, you hear?"

"Mel, we'll need help. I should call the sheriff—I would have, but I wanted to warn you first."

Mel was out of his cab, phone clamped to his ear with his left hand while with his right he struggled with the coupler. The pin came loose all at once and he dropped it on the ground. He left it there, and turned the valves that shut off the flow of hydraulic fluid to the planter's control system.

"Wait on that, Alice. Wait until I have the house in sight." He paused, and twisted loose the last coupling. Then he continued, "Tell me how many there are and what they're doing."

"I've started counting but lost track when some of them went around behind the house. It looks to me like there are at least ten of them. They're not all the same size, but every one of them has a spear, and some of them have other things that could be weapons. . . ."

"The planter's loose, I'm on my way, Alice. What are they doing?"

"Mostly gawking around. A couple of them went into the barn. I saw a couple more chasing geese. There's a couple trying to get into the chicken house but they don't seem to know what to make of the wire."

"I'm out of the field, Alice, making good time now. I'll be there in a couple of minutes. What do these things look like?"

"Two arms, two legs and a head, Mel. No tentacles, no fangs, no claws. They're all wearing ragged-looking clothes. These could be skins, and they look dirty. None of them have gotten close enough for me to tell much about their faces, if they have faces. All I can really be sure of is that they aren't human."

"I've got the house in sight, Alice. Hang up and call the sheriff, then call me right back, OK?"

"OK. Be careful, Mel. I think the tractor'll scare them off when they see it but you never can tell about aliens."

"I'll be careful. Now do what I told you." Mel waited for the click, then he hung up too. Alice's last quip, as though she was experienced in dealing with extraterrestrials, was typical of her. Alice was soft and cuddly most of the time, but hard as nails when circumstances demanded. No alien was likely to get in the door without getting his hide riddled. Besides, Mel knew from watching *Star Trek* that aliens weren't dangerous unless they had cranial deformities.

It seemed like an eternity before his phone buzzed. Mel answered immediately.

"I didn't tell him much, just that there were about a dozen armed strangers here," she said. "He's calling Eddie, and they'll bring enough muscle to control things without any outside help. At least, that's what he hopes. I don't think the sheriff much cares for the feds."

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"Who does?" Mel quipped. "Oh-oh, they see me."

"They sure do, Mel. They're scared. They're gathering. One of the cats is dead. I saw an alien come out of the barn holding it up by the tail. But he dropped it when you showed up and now he's in the crowd somewhere."

"You know what I think, Alice? This bunch didn't come on any space ship, they're savages. I don't think they're hostile, either. I think we ought to call the sheriff off, at least for now, and try to make friends with them."

"Make friends? Mel, they've invaded our home. They're after our animals. They killed our cat."

"They might be starving for all we know, Alice. The cat was meat, and they wouldn't know these aren't wild animals. I'll bet they don't even know what a farm is, or a house, for that matter. They may not realize there's an inside to it. I think it's worth a try, Alice."

"No, Mel. . . ."

"You can cover me from the second floor window—and I'll take the twelve-gauge. They won't know what it is. They'll probably figure it's some kind of club." Mel was already out of the tractor's cab, and walking slowly toward the house and the crowd.

Before Alice could say anything more he added, "I'll call you back before I get too close, Alice. I'm going to hang up and call the sheriff—tell him to surround us but not to move in. We'll be all right, Alice." There followed a click.

By the time Mel was within shooting range of the crowd he had finished his call and was back on the line with Alice. "They'll cooperate, Alice. I talked to Eddie, too. He agrees this is a good idea."

"Naturally, he would," Alice replied sarcastically. "He's not the one who'll get shish-kebobbed if you guessed wrong."

"If we don't do it this way the government will move in and take our farm away from us. They'll hog everything. We'll be ruined. This way, we keep control. We can count on our neighbors, but not on strangers."

"Maybe we can," Alice argued, "but are they up to it? We don't know where these people came from or how many there are."

"Eddie thinks it's a parallel world," Mel beamed. "He says it's as good an explanation as any, especially considering nobody saw anything in space. He says there's probably a hole that's been there for billions of years, that opens and closes periodically. That'd let things mix a little, if animals went in both directions. Eddie says that explains some of the structural similarities; animals that originated here went through and took totally different evolutionary paths from what they had here. Some that went extinct here thrived over there. All we'd have to do to find out for sure is go through and have a look around."

"I'm not curious enough to risk becoming the widow Simmons," Alice replied, the sarcasm gone from her tone. "You'd better find a way to warn these things that I'll blast the first one who raises a spear at you."

"They'd have done it before now if they planned to, Alice. Only some of

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them have real spears. The rest have atlatls—they can throw them. Probably coulda' hit me a long time ago. They didn't even raise them. I don't think these people are looking for trouble."

Mel continued his advance until only about 100 feet from the nearest of the strangers. He had unfolded the phone's head clamp so he could talk with both hands free. "I'm sure this is just a hunting party now, Alice. And from here, I can see that all the weapons have stone points." He raised his arm and waved at the strangers.

When every one of them waved back and none raised a weapon Mel was sure he was right, and he told Alice so. "You said TV was a waste of time, Alice, but I learned a lot from the nature programs, including that most primitive people usually aren't very warlike."

"And here I thought you watched because you liked to see the naked women," came her riposte. "If you don't mind, I'll keep my finger on the trigger."

"Fine, just don't shoot anybody. Uh—Alice, do you think we could spare a couple of chickens?"

"Now you want to give them my chickens?"

"No. I want to throw a party, and we'll need some refreshments. Why don't you come on out, Alice?"

"To do the cooking?"

"The sheriff's got the crowd covered, Alice. Every one of these guys is in the sights of somebody's rifle by now, there's no danger."

"Sez you? OK, Mel, but I'm not only keeping my shotgun, I'm bringing your thirty-eight."

"Bring some matches too, Alice. That ought to impress these guys."

It did indeed. It scared them at first and left the savages in reverent awe of everything else Mel did afterward. He had become, in one faint spark, and with a whiff of sulfur, the most accomplished magician they had ever seen.

Alice was completely disgusted, and went off to select a couple of chickens for the feast. She too, created a sensation when she disemboweled these with a stainless steel knife and washed them under the stream of water from the backyard pump. By the time that was over there wasn't any danger of violence, the strangers were in total awe of their human hosts.

So they sent for Eddie, who arrived in a timely fashion, shortly after the eating started. Gerald Aberg was with him. The fact that both of them agreed with all Mel's theories disgusted Alice almost as much as the smug attitude this had produced. Mel could be insufferable at times, and this was one of them.

Nobody understood anything the other bunch said, of course, but there did turn out to be plenty of common gestures. Sticks provided the means for crude drawings, which soon appeared to confirm Eddie's parallel world idea.

The entrance to Earth, it seemed, was like a tunnel between two soap bubbles, apparently surrounded by a halo of some sort, which Eddie believed was simply daylight showing

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through. "It probably works the other way, too," he remarked, "and that would explain the glow you saw when that last monster came through. Their days are out of synch with ours."

To confirm the theory Mel used his cell phone to call the sheriff and give him the vector. Only a few minutes later the news came back—there was indeed an opening between the worlds. Also, there being a strong probability that pesty little creatures might wander through it and infest local crops they put a guard on the hole. If it developed that the site was stationary they would later consider installing some kind of door on it.

The feast went on.

Mel and Alice had retired as soon as the aliens had bedded down for the night. Their farm was like a boy scout camp, with about half of the sheriff's posse sacked out in the barn and two men up at the site of the hole, watching for other varmints that might come through.

The geese had not had time to become completely comfortable with the situation so whenever there was any movement down below they continued to give their alarm. Alice had no trouble sleeping through this. Mel did.

He looked at the clock when the latest interruption came, groaned at the time, four o'clock, and thought about how he would feel out on the tractor in this condition next day. He still had to finish that planting that was already late.

Nevertheless, when the honking continued beyond what he thought was normal, he got up and went to the window.

There were four or five men milling around outside the barn. The sheriff was one of them. He could see Eddie and Aberg were too, and the two aliens that Eddie had begun to call the "alpha pair." The latter were gesticulating wildly but nobody seemed to be paying any attention to them.

Mel decided to go down. He put on his robe and slippers and tiptoed out, pausing by the door to grab his shotgun.

The sheriff seemed quite surprised to see him. The sheriff looked very upset.

"What's happening?" Mel asked naïvely.

"Something got Dave Bridges," the sheriff replied. "And his brother's missing. They were on guard at the hole, but when the relief went up Bobby was gone and all that was left of Dave was his right foot."

Mel was visibly shaken. He clutched his gun a little tighter and shivered. "Any idea what it was?"

"Not a clue, Mel. If I could talk to these—these alien ape men—" he paused and sighed. "I'm sure they'd know what we're up against but there's no way I can ask them. We got the word over the radio but they don't even know there's anything wrong yet."

"If you're going up I'll get dressed and go with you."

"Then hurry up. Eddie and the tracker already left. I was gonna' try to explain to the aliens and get a couple of them to come along. We might

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need another gun before we're through."

Mel disappeared and returned less than five minutes later, all ready to go. By then, the sheriff had the alien heads nodding over a drawing in the dirt that showed the hole as a circle and a couple of stickmen with their limbs broken or severed. Mel couldn't read any of their facial expressions, of course, but the faces were animated in an entirely different way than before.

When the sheriff and Mel started for the hole the two biggest aliens fell in and marched off with them. They talked to each other in hushed voices, which suggested they might already suspect what had happened but couldn't figure out how the humans knew about it.

At the hole Dr. Aberg was in a highly agitated state. His big electric lantern lit a wide circle around the barely discernible periphery of the hole. There were tracks, lots of them, and a great deal of fresh blood.

A gasp went up from the aliens, followed by much murmuring. They knew at a glance what had happened, and they wanted to tell the humans what they thought.

Aberg already suspected the guards had been attacked by a cat. The signs were clear, he said, with claw marks appearing only intermittently. This indicated that the claws were retractable, as in all Earth's large felines except the cheetah. These were, however, very much bigger than even the Siberian tiger's pawprints, and the Siberian tiger was the biggest modern cat there was.

One of the aliens squatted, and smoothed out an area of bare ground before upending his javelin to draw. The drawing was crude, of course, like the sheriff's stick figures, but there was one special feature that nobody could miss, the saber fangs. The alien had drawn a *Similodon*.

"There haven't been any of those on Earth since the Pleistocene," Eddie gasped.

"This was a big pussy cat," the tracker added. "We better hope it went back through the hole instead of off on our side of it."

"It'd be easier to find Bobby if they were over here," the sheriff replied glumly.

"They're not, Sheriff," Aberg answered. "See those scuffs? The cat couldn't hold Dave clear of the ground for very long at a time, so he intermittently dragged him." He paused, flashed the light ahead. "Bobby was still OK when this happened. There's his tracks following. Uh, Sheriff, we're gonna' have to go on through."

The sheriff glanced around. Besides himself, the tracker, Eddie and Mel, and the two aliens, he had the two deputies who had relieved the missing guards. You guys stay here," he said. "Get on the radio and tell the rest of them what we're doing. I'll take my handset along and report back to you on that. As long as we're in range, that is."

"What about getting some more help?" One of them asked.

The sheriff thought a moment. He studied the aliens. "No, not yet. I've got a feeling these guys are used to dealing with the cats, and we have the

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firepower to handle them once we know where they are. We'll wait."

The party started through, with the two aliens and Aberg in the lead.

The character of the land on the other side was radically different, the air a little cooler despite the fact that on this other world dawn was just beginning. Much of the vegetation closely resembled terrestrial types, at least to the untrained eye, but seasonally, that world seemed to be behind Earth. Here, it was still winter, and this vegetation was dry, with withered leaves, and there were occasional patches of ice and crusty snow.

"Blood!" the tracker shouted. "And spent brass." He shined the light on the ejected cartridge, then picked it up. "Bobby was still alive and kicking when they got here." He paused, flashed the light some more. "The cat stopped and turned on him, but didn't chase him. Bobby ran back a ways."

He followed the human tracks until they too stopped and turned, then bent down and picked up two more brass casings. "He got off two more shots, too. Let's move ahead and see if he hit it."

They crept forward, and as they did the aliens became very nervous. Both of them were sniffing the light dawn breeze, nostrils twitching as if to gather more of the scent. Mel began to see more and more of the logic in Eddie's new theory. These aliens did seem to be more a pack than a tribe, and they did seem to share a close relationship to an old and honored terrestrial species.

As Mel watched he caught a little of their concern and checked to see that the shotgun's safety catch was off. The aliens didn't know about guns, of course. None had been fired when they were around, which left Mel wondering what they would do when all of a sudden they had that experience. He expected panic, and that the aliens would be useless as allies until this cooled.

Another thought gave him more comfort; he had a twelve-gauge shotgun, whereas Bobby had been armed with a thirty-eight caliber pistol. Up close, even a tiger shouldn't be able to take more than one load of that.

"Up there," the tracker yelled. He was shining his light in the direction in which the aliens pointed, into a jumble of bushes and boulders far to the right. "It's like a cavern. The aliens must think the tiger's in it."

"Then, where's Bobby? Unless the cat turned on him again, and got him, he ought to be around."

Before anymore could be said, or anything decided about how they would approach the cat's lair, assuming that was what this was, the aliens took the initiative. One of them guided Aberg's arm, and the light, to the crest of this little rise from which the outcropping protruded. Four glowing eyes, not just two, appeared in the beam; two cats, not one. With this intrusion, came a jumble of low roaring. Both cats then rose, saber teeth glistening, muzzles dripping red.

Mel now realized that Bobby had become dinner for the second cat, just as his brother was for the first. He raised his gun, ready to start forward.

The aliens had other plans. The air whistled. Two dark streaks raced to-

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ward the cats. Two agonized howls followed. Both cats suddenly lurched and stumbled. It was over in an instant. They both dropped lazily to the ground and moved no more.

The aliens turned to gaze at the startled humans, as though they expected to be congratulated.

Mel was sure that had he been able to read their expressions these would have been grins of pride. They had done an amazing thing. With these primitive weapons they had overcome two ferocious beasts that had defied the efforts of men with guns. How? He wondered. It didn't look to him as though the javelins had struck in particularly vulnerable places.

"The javelin heads were poisoned," the tracker gasped. "Perhaps with something like the curare the Amazonian Indians use." His thinking was far ahead of Mel's. "Let's go up."

Cautiously, they did. Mel found himself wishing he hadn't. His stomach was not prepared to meet the challenge. The sight of the gnawed bodies was more than it could take. Mel found he wasn't the only one.

They were looking for the hole and couldn't find it. During the time it had taken to bury what was left of the Bridges brothers daylight had arrived on both worlds, and that complicated the problem somewhat. But it wasn't the entire explanation, since backtracking their own footprints should have led them right to it. And it hadn't, and that meant the hole had moved.

While the humans muddled around, cursing their luck and in near panic, the aliens were busy solving the problem. It wasn't very long until, to the chagrin of the humans, one of them winked out like a light. The hole, it seemed, had migrated to local south, some 200 feet from where it had been the night before. So much for an idea Mel had been cooking—to put a big, strong door over the hole.

In a few seconds they were through, and they could see that there had been a similar migration on the other side, although the distance was disproportionate. The Earth-side hole was only about six feet off the mark.

Back at the farmhouse the rest of the aliens and the posse watched their approach with trepidation. The aliens relaxed as soon as they saw they had suffered no casualties, and ran out to great their returning pack leaders with much sniffing and face licking.

With the humans, the reaction was mixed relief and horror, but they bore the news stoically.

"We've got to get the community together and decide what to do about all this," the sheriff announced grimly, after briefing the posse. "And," he added, "we have to keep all of this strictly to ourselves."

He picked out two deputies. "Go into town," he said. "Get hold of everybody you can. Don't tell them why, but say there'll be an emergency meeting on the town square at four o'clock. Tell them we want at least one adult from every family but to leave the kids at home. Got that?"

The deputies answered with nods.

The sheriff turned to Mel and Alice. "I hope you understand, this isn't just your problem anymore, it's every-

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body's. With that hole floating around like it is it could be anywhere within a month, and we have to be in a position to control what goes in and out of it."

"I just want to get my beans in," Mel replied.

They sat in a small circle in the center of the crowd. The community wasn't a large one, only about seven hundred people in all, counting children, so Athenian style democracy usually worked out pretty well.

All of them knew about the strange varmints, of course, but the secret of last night's events had been well kept. So even with forewarning the sight of the aliens emerging from the sheriff's van raised a murmur.

"They're friendly," the sheriff assured the crowd. "We can't talk to them yet but so far we've been getting along fine."

The crowd settled down.

"We have to figure out what to do. That's why I asked you to come here. We haven't got much time to do that, and if we make the wrong choice all of us could lose everything we have. But Dr. Aberg's got an idea so I'll let him explain it."

The tracker stepped forward. He had been up all night. He looked haggard. But his voice was firm. "I know people who would kill to be here," he began. "This is without a doubt the biggest scientific breakthrough in history. It not only can change the course of that history, it already has. The very knowledge that this anomaly exists will change every cosmological theory man has ever conceived.

"It has a dark side too. This community is about to get a demonstration of just how greedy human beings can get. You have something worth stealing. It will be stolen, that is a certainty. This is the way things are. The best you can hope for is to save something from the wreckage. That means you have to plan. You have to pit one greedy guts against another, and you have to do this not only to save yourselves, but to save them." He pointed to the aliens.

"These people are primitives, as innocent as our own aboriginal people were when we stole all this from them. We did it all wrong before. This time we have to do better.

"If we do nothing to stop them then as soon as the news leaks out, as it inevitably will, Big Brother will move in and confiscate it, and instead of society as a whole gaining the benefit of this discovery the bureaucrats will descend on it like a cloud of maggots.

"The only counterweight to big government is big science. They can't match the federal bureaucracy moneywise, because they don't have the power to suck up your tax money like the government does. But they're pretty well-heeled even so, and more importantly, they have an awful lot of clout with the news people.

"This is what I propose we do." He paused, and a smile washed over his face. It was contagious. As he continued it migrated out into the crowd. Pretty soon everybody had one, even the aliens, who although they didn't understand any of it, mimicked their human friends.

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When Aberg finished, the history of both races had been determined for the next millennia—all in one afternoon.

"It worked!" Norman Simmons was ecstatic. Ahead of him, on the gigantic screen that served the transport module as a front windshield, the magnified image of the Milky Way Galaxy gleamed sharp and clear, though minuscule in comparison with the rest of the image. Norman had expected this, of course. Their view was from within Andromeda, from the surface of a cold and airless world circling a dying sun.

In the couch next to him Borah Kahn was no less enthusiastic, no less elated at their accomplishment, though she had subdued the urge to climb into his lap and lick her companion's face. By nature, *Canis sapiens* was more demonstrative and team-oriented than *Homo sapiens*. They had, after all, evolved from different species of cooperative hunters. In the end, the civilized side of her won out. She regained her composure and let her practical, female side mask the lapse. "We still have to get back, you know."

"I know. But we'll have a couple of minutes to enjoy this, Borah. This hole is stable, just as they predicted. Look at the figures for the drift." He pointed to a window on the screen of the armrest console between them. "It's the distance, Borah. A galaxy is far less mobile than a single planet. You know what that means."

She did. It meant that with refinement of the mathematics the location of anomalies could be predicted, and many more worlds would be accessible. More than they could ever visit in their lifetimes.

"The sensors are mapping everything," Norman added. "We'll be important people when we get home."

"I know. It scares me." And it did, really. Borah Kahn was more than a little sensitive to the fact that hers was the junior of the two races, that hers did not have the hundred centuries of civilization behind it that Norman's did. It had been his people, not hers, who possessed the scientific knowledge to keep the anomaly between their worlds more or less open. Her grandparents had truly been savages by comparison. She was only three generations out of the stone age.

"It's time to start the return program, Borah. Are you ready?"

"In a moment," she replied. She turned her attention to the console, where the transfer data was now appearing in a steadily creeping scroll, in numbers and symbols that would have made no sense whatsoever to her recent forebears.

Borah felt suddenly humbled by it all, by the thought that almost none of what she saw was really hers, that nearly all of it was man's doing. What a fantastic turn of luck it was, she thought, when we encountered humans. How wise they are. How generous. "Ready," she said, and stabbed the "enter" key.

The transformation was all but instantaneous. Once back on Earth they had only to open the hatch and meet the crowd of well-wishers.

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Norman's grandparents were there. He went to them and embraced them while Borah stood nearby.

"For once," Mel said, turning to Alice, "it looks like humanity finally got something right."

Borah was puzzled, even a little hurt. There were subtle differences in the thought processes of the two species, she knew, but not enough to explain this. What did it mean?

No matter. To her the humans were the same as always, fine and noble and wise. They would always be the leaders, and she would always be content to follow. Man was the alpha. That was the way things were meant to be. ■

The only thing I like about Mars is that the gravitational pull there is so slight that one could jump three times as high as one can on Earth, but that would hardly be worth the trip. I suppose the novelty would soon wear off.

—Will Cuppy

No matter how showy atom-smashers and spacecraft are, there are still some subjects that just can't be manipulated or meddled with in a laboratory. It'll be a long time before a geologist can start an earthquake or volcano for the purpose of an experiment!

—P. E. Isaac Bonevits

Few laymen know or even care to know the principles that guide science; we accept the results on faith, and like the peasant we simply defer to the accredited experts of the tradition. Yet we scientists work under the constraints of our own illusions.

—Wade Davis

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BURN UP THE NUCLEAR WASTE

Disposing of nuclear waste, the massively radioactive leftovers from nuclear power reactors and from W.W.II and Cold War era nuclear weapons programs, is widely considered to be an insoluble problem in the USA. It is basically a problem of time scales and politics. Many of the radioisotopes in nuclear waste require many thousands, even millions of years to decay naturally to an acceptable level of radioactivity. The problem appears to need a disposal solution that covers such a geological time scale, while our political processes are geared to a time frame set by the date of the next election.

Nevertheless, the problem of nuclear waste disposal is not insoluble. Good technical solutions have existed for at least 20 years, but for political reasons none has ever been implemented. This could be changing. New accelerator-based technical solutions are perhaps more politically acceptable. This column is about this emerging technology.

Before discussing solutions, however, let us consider the problem. The intense radioactivity of the waste produced in a nuclear reactor comes from two sources: (1) light nucleus fission products consisting mainly of elements 38 (strontium) through 67 (holmium) and (2) transmuted heavy nuclei consisting mainly of actinide elements 90 (thorium) through 96 (curium).

The light nucleus component of nuclear waste is made when uranium or plutonium reactor fuel splits (or fissions) with considerable energy release into two lighter nuclei. These fission products typically have too many neutrons for stability, making them highly radioactive as their excess neutrons are converted to protons through beta decay (emission of an electron and an anti-neutrino).

The heavy nucleus component of nuclear waste is made when the uranium or plutonium reactor fuel is transmuted to heavier elements by neutron-induced reactions that do not lead to fission. The resulting heavy nuclei tend to be radioactive through the process of alpha-decay (emission of a helium-4 nucleus). They decay toward stability in a linked sequence of alpha and beta decays called a "decay

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chain," the completion of which requires about 100 million years.

The decay rate of a radioactive nucleus is specified by its half-life, the time required for half of the radioactive nuclei in a sample to decay. It is a remarkable accident of nature that nuclear waste contains no important fission product isotopes with half-lives between 90 years and 70,000 years. Therefore, nuclear waste can be considered to consist of a heavy nucleus actinide component A, a short-lived light nucleus component B with half-lives less than 90 years, and a long-lived light nucleus component C with half-lives greater than 70,000 years. The radioactivity of component A is dominated initially by the actinides ^{244}Cm (half-life 18 years), ^{243}Am (7,380 years), ^{238}Pu (87 years), and ^{241}Am (432 years). Component B is dominated initially by the fission fragment isotopes ^{137}Cs (half-life 30 years), ^{90}Sr (29 years), ^{106}Ru (1.0 years), and ^{134}Cs (2.1 years). Component C is dominated by the fission fragment isotopes ^{99}Tc (half-life 210,000 years), ^{93}Zr (1,500,000 years), ^{135}Cs (2,300,000 years), and ^{129}I (15,700,000 years).

When the nuclear waste is first produced, the radioactivity from component B produces about 99% of the overall activity level. The radioactivity from component A is about 1% of the overall activity level, and the radioactivity from component C is only about one millionth of the overall activity level. After about 300 years the short-lived isotopes of component B decay away. After this the radioactivity from component A is the dominant source of radioactivity and is always greater than that of component C by a factor of 10 to 100.

The 20-year-old prescription for disposing of nuclear waste is straightforward. (1) Perform a chemical separation on the waste which extracts the actinides of component A, all of which have similar chemistry and can be readily separated from the rest of the nuclear waste. (2) Glassify the remaining B and C components by fusing them into a ceramic material and store them in an underground storage site for several hundred years. And finally (3) concentrate the A component in reactor fuel pellets and "burn" the actinides in a breeder reactor or other intense source of fast neutrons.

With this strategy the problem of nuclear waste disposal is simplified, since in about 300 years the B waste component will be "cold," leaving only the C component which has an activity level that is a million times lower than the initial level of the waste. Perhaps more relevant, the cooled waste is far less radioactive than the rock from which the uranium reactor fuel was originally mined or the mill tailings generated when the uranium ore was processed and refined. Therefore, political concerns about the integrity of a storage site can be limited to a time scale of a few hundred years.

The A component of the waste was separated out because the actinide decay chains produce a level of radioactivity that is ten or more times larger than that of component C, that continues to decay for millions of years, and that is a severe health hazard if in-

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gested or inhaled. In a high flux of fast neutrons, however, the actinides have a high probability of transmutation leading to fission, and thus can be "burned" to eliminate the A waste, producing energy in the process.

This scheme, unfortunately, is not currently feasible in the USA. The barriers to implementing it were erected in the 1970s by Cold War politics. During the Carter Administration (1977-81) the chemical reprocessing of spent nuclear fuel was considered a technology that encouraged nuclear weapons proliferation (by extracting from spent fuel rods plutonium that might be used to make bombs). President Carter therefore ordered the U.S. program for chemical reprocessing of nuclear fuels terminated "to set an example for the rest of the world." At about the same time, the U.S. program to develop a high flux fast-neutron breeder reactor at Savannah River was terminated for similar reasons. The net result was that the two key technologies needed for effective disposal of nuclear waste were eliminated by political decisions. Neither technology has ever been restarted in this country, although France and Japan now have active programs of both nuclear fuel reprocessing and breeder reactor development.

The breeder reactor is so named because its high flux of fast neutrons transmutes ^{238}U to ^{239}Pu reactor fuel faster than it consumes its ^{239}Pu fuel, thereby making more fuel than it uses. It has proven to be a difficult technology. To achieve the needed neutron flux, a breeder must operate at a very high temperature, so high that it cannot be cooled by boiling water. The French and Japanese breeder reactor designs both use liquid sodium metal as a coolant, a solution which looks good on paper but has proved troublesome in practice because sodium is a very reactive metal that ignites on contact with air or water. France and Japan have both had problems with the liquid sodium plumbing in their breeder reactors. Just last month, for example, a Japanese breeder prototype spilled several tons of non-radioactive but chemically hyperactive sodium inside a reactor containment building.

Since the USA has neither the chemical technology for separating out the actinide A component of nuclear waste nor a high flux fast neutron breeder reactor in which to burn it, the only remaining alternative is to store the unprocessed nuclear waste underground for many thousands of years. This alternative has met with massive opposition, particularly from states in which the nuclear waste repository might be located and from individuals who live near the selected storage sites. The result is a political stalemate in which no progress or decisions are being made, while spent fuel rods pile up in temporary storage areas at about 100 operating reactor power stations.

This brings us to the new approach to the problem of nuclear waste disposal. It does not require a breeder reactor, and instead uses a particle beam from an accelerator. The idea is to direct accelerated particles, for example 1 GeV protons, into a small, specially

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designed sub-critical nuclear reactor in order to produce a "hot spot" in which the reactor is super-critical and a high flux of fast neutrons is present. Neutrons produced by spallation of heavy nuclei by the particle beam are "amplified" in surrounding uranium or thorium, leading to a "hot" region near the particle beam where the density of neutrons is high enough to burn actinides. While a breeder reactor generates heat and fast neutron flux that is broadly distributed over the whole reactor core, the particle-beam activated reactor produces heat and a very high flux of fast neutrons in a localized region. This makes it easier to cool, greatly simplifying the design.

The advantages of this approach over a breeder reactor are: (1) it is cheaper to design and construct, (2) the heat is localized and easily cooled, (3) the process is very stable and immediately ceases when the particle beam is interrupted, and (4) localized neutron fluxes considerably larger than those present in a breeder reactor can be achieved.

The design of such systems has been a "hot item" at conferences. At a recent meeting in Susono, Japan (see reference below), independent groups from Russia, Japan, Brookhaven National Laboratory, and Los Alamos National Laboratory all described investigations of variants of this scheme, usually involving high-current proton beams with energies around 1 GeV. Production of such a beam would require construction of a fast-cycling synchrotron accelerator costing perhaps a hundred million dollars, quite cheap compared to the multi-billion dollar cost of a breeder reactor. Published simulations have demonstrated the feasibility of nuclear waste transmutation using this scheme. The process could even achieve "energy payback" by generating enough electrical energy to operate the accelerator, with a surplus to sell to commercial power companies.

This technological development does not solve the whole problem, of course. Chemical processing of nuclear waste would have to be re-established in this country so that the actinide component of the waste could be concentrated for burnup. In the present post-Cold-War political climate, however, there is less concern about setting an example and more concern about disposal of the great surplus of plutonium left over from Cold War Era bomb production, material which could also be burned in an actinide disposal facility. This climate change should make it easier to reestablish a reprocessing facility in the USA.

There remains, of course, the overall problem of the public perception of nuclear energy. Any potential exposure to radiation can produce a strong public reaction, even an exposure that is many times weaker than the natural background radiation in which we all live. The association of nuclear power generation with nuclear weapons production and with the devastating Chernobyl accident has been firmly implanted in contemporary thinking. And the inability of the news media, the U. S. Congress, and a large segment of the general

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public to deal rationally with issues involving probability and risk assessment is a very serious limitation. A practical consensus solution to the problem of nuclear waste disposal through burnup might go some distance toward rehabilitating nuclear energy as a viable energy source, but it would not solve these fundamental problems.

Perhaps this will diminish only with the dawning realization that the carbon dioxide produced in burning massive quantities of coal, oil, and natural gas for power generation is a major contributor to the progressive rise in the CO_2 fraction in the atmosphere, now generally acknowledged to produce global warming. Solar energy, geothermal energy, and wind energy, after two decades of subsidy and major DOE investment in research and development, have proved to have negligible potential for large-scale power generation. Hydroelectric power generation has few new sites available and brings the unwanted side effects of dam silting, damage to the natural environment, and devastation of wild rivers and salmon and trout spawning runs. Nuclear fusion is still many decades away from any practical application.

Nuclear power generation technology stands out as the only presently viable technology for large scale power generation that does not contribute to the problem of global warming, but it is only viable if the waste disposal problem can be solved. The emerging technology of accelerator-controlled waste burnup is perhaps a significant step in that direction.

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Alexis Glynn Latner

THREAT OF STARS AT 912 MAIN

Locals usually have mixed feelings about tourists—for good reasons!

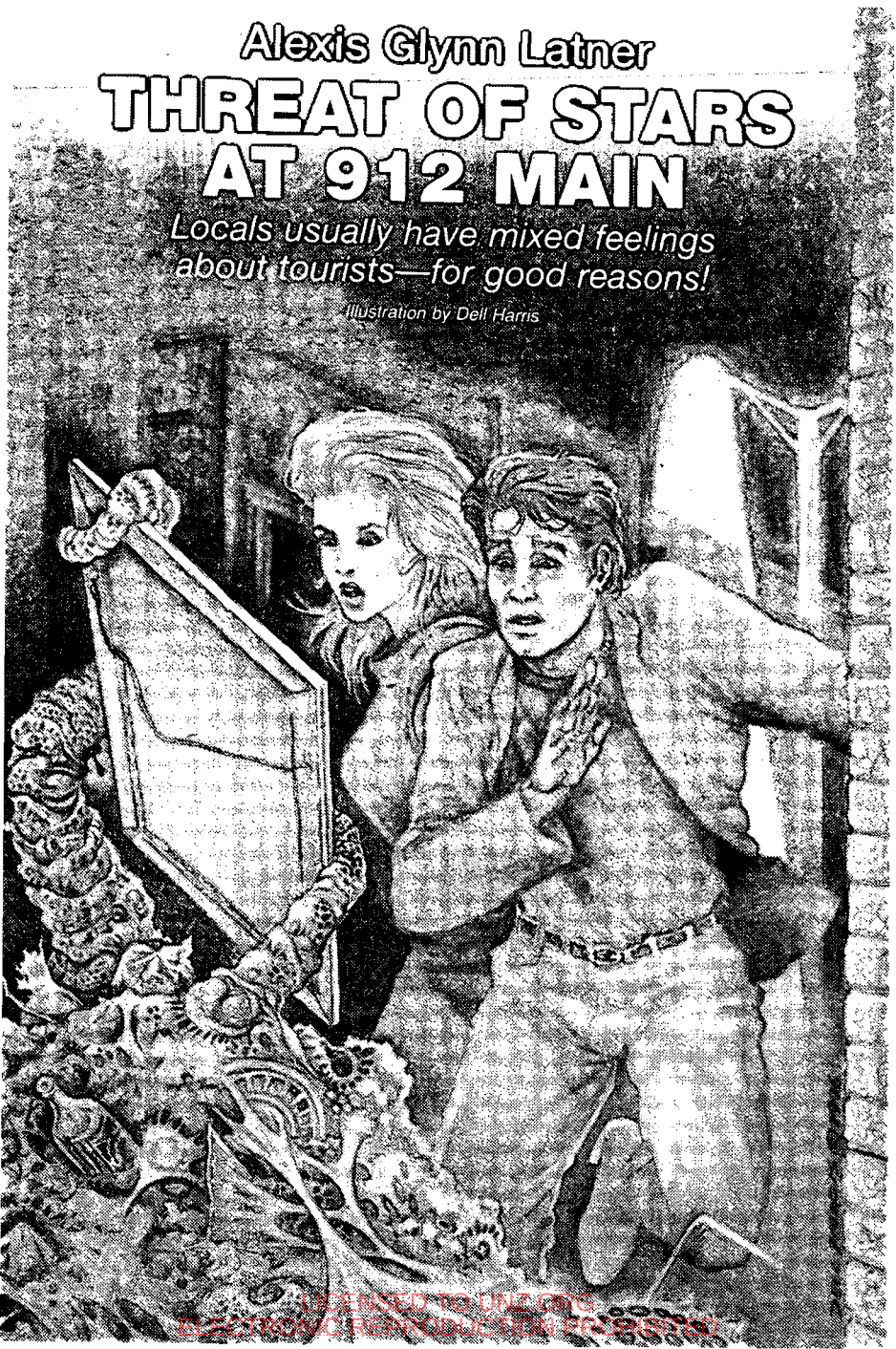

Illustration by Dell Harris

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Michael Martin, the photorealist, is alive and well and painting in Houston, and nearing the completion of his best work to date. That's a great capsule bio, isn't it? Especially considering the rest of the whole truth. *He nearly ended up either dead or disappeared off the face of the Earth.*

It was a close call as to which outcome it would be. And the irony is, I wasn't looking for a new painting idea that night. Or for trouble either. It all just happened out of the clear, black, night sky.

Thursday night, July 22. The art opening was going great at first. My paintings had a white wall to themselves, with track lighting that showed them off to best effect. The rest of the group show at the Hart Gallery was strong, too. We had Thaddeus Cooper's Afro-American-motif collages, Tam Adkins's surrealist paintings, sculpture from the studio of Ben Glaze, and drawings in charcoal and crayon by Roger Easterling. There was only one mistake in the show—a messy, three-dimensional, mixed-media piece, situated in a corner between Thaddeus and Roger, so I wasn't sure which of the two was responsible. At least it wasn't dragging my stuff down. I'd already spoken with a potential buyer, a lawyer with offices downtown. He sounded serious about buying my painting, "Bayou Gothic Skyscraper."

Then Roger came up to me. Besides having art in the show, he was the gallery owner's assistant, and looked artistically official in tuxedo and mint-green, ruffled silk shirt. Roger was handing out drinks and news. "Guess what? A Miguel Herrera painting has disappeared from the Artes Magnificos Gallery! White or red?"

My name, Michael, is the Anglophone equivalent to that of Mr. Herrera, who's a local photorealist with a national reputation, and my idol. So Roger's news got my attention. I accepted white wine in a plastic cup and felt suddenly, absurdly worried.

It was the busy Brownian motion of a well-attended opening in here tonight, with people uniformly dispersed throughout the gallery space. Except the artists clustered around Roger. "Another art theft? No foolin'!" exclaimed Thaddeus Cooper. "That makes five in five days."

"Nights," Roger corrected. "The thefts all happened in the middle of the night."

"Does what's been stolen have anything in common?" I wanted to know.

"Works in five different media and styles that range from Baroque to avant-garde," Roger answered, "are missing from the Fine Arts Museum, the personal studio of Victor Leibrock, and two commercial galleries."

"Any of *us* might be next," said Thaddeus in a droll tone.

I laughed. But deep down, I felt threatened. There's nothing like not having made it quite yet. Miguel Herrera could afford to lose a painting; his go for five figures each. But I had everything to lose. At least that's how I felt, imagining what if my "Bayou Gothic" vanished off the wall of the Hart Gallery.

"The art theft wave is why I'm playing hostess," Roger said. "Annika's at the gallery owners' association emer-

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gency meeting. I did the last of the setup without her."

Tam Adkins, the painter who'd recently moved to Houston, asked, "Do gallery owners here have an association? In Atlanta they cooperate about like a sackful of cats."

"Same here, but they associated last spring when City Council considered zoning restrictions such that galleries in upscale residential neighborhoods would have been zoned out of business. And now the art theft wave has them meeting again. Welcome to Houston," Roger said brightly.

Elsewhere in the gallery, some art professors were having a loud discussion. Standing around the mixed-up-media piece, the academics argued with each other about its relevance to Derrida and deconstruction.

"Do excuse me. I have patrons to attend to." Roger glided away toward the professors who, while arguing over the mixed-media piece, weren't looking at it, and the art critic and photographer from the newspaper, who were.

Thaddeus nudged me. "Roger's going to get some press with that mixed-shit piece of his."

So it was Roger's. I should have known. "Maybe the art thief will read the review and come steal it," I muttered peevishly.

The profs and the art critic drifted away from the mixed media, but a gaggle of glitterati replaced them. Meanwhile, nobody hovered in front of my work.

I do photorealism. Huge paintings of city scenes. I prowl the streets looking for interesting angles; I've been known to lie in wait until some combination of Sun and shadow, or mist and moonlight, gives a unique lighting effect to a skyscraper. In other words, I work hard to understand and to depict the reality of the stone, steel and glass bones of this city.

And the art-opening crowd preferred the messy little mixed media. Feeling faintly green, just like the wine in my cup tasted, I went over to take a close critical look at Roger's folly.

Importantly placed on a display pedestal, it incorporated a dayglo sneaker, a giant plastic cockroach, wads of crumpled paper and used bubble gum, and a green plastic comb. It looked like what you'd find on top of a clogged storm sewer after a downpour, balled up into a mess about two feet across, and stuck together with orange paste looking suspiciously like the gasket goop that mechanics use.

Thaddeus was right. It was shit-awful. To top it all off, the thing was titleless. I started to scan the floor in case the title card had fallen off, but a girl in a clingy blue dress informed me, "We already looked. There isn't a title card. Having no artist and no title is such a provocative statement."

"Uh-huh." In my own opinion, the lack of a title card was excessively coy.

With eyes to match her dress, she gave me a shimmering blue gaze. "Are you the artist?"

She was an art babe, one of the attractive young women who are fascinated by the art scene, don't earn enough money to collect art, but do

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have charms wherewith to collect male artists. As it happens, art babes aren't the type for me. I said, "No, this is a Roger Easterling."

She wasn't Roger's type either, since she was the wrong gender for him. But he deserved the trouble of fending her off, after inflicting his Mixed Media on the show.

By now I was brooding about the whole fine arts business and the way it pandered to tasteless, moronic money. About my eventual success as a painter, or lack thereof. And inside all of the brooding a thorn of irrational fear was sticking in my side. Suppose "Bayou Gothic" was the one that would knock the critics' socks off, that could implant the seeds of a real reputation for me in the art world, but got stolen instead?

It was distraction time. Before I could wind myself up any tighter and completely ruin my mood for the opening, I went over to check out Tam Adkins's work.

One of Tam's paintings fascinated me. Measuring a couple of feet long on each side, it was half of the size of what I usually do, but exquisite. She had painted computer chips and electronic parts and laboratory glassware—with light reflections rendered just right—a melange of technological artifacts, assembled in such as way as to look like a portrait of a man. It alluded to a famous classical painting in which the human portrait was an assemblage of fruit. But it accomplished more than mere allusion. "Hey, 'Technology Number 7' is great, including your technique. Masterful," I told her.

Tam responded with a bright smile. She wore a short vermilion dress and—something I check when women seem to exceed me in height—flat shoes. Tall lady. "Michael, can I show you something really odd?"

To my exasperation, Tam led me back to Roger's mixed media. Pointing to the giant plastic cockroach stuck onto the side of the mess, Tam said, "I think that moved."

I gave a cynical chuckle. "It's not alive—not even Houston has roaches that big. It's a novelty from the party supply store on South Main street."

"What I meant was, the whole part moved."

"Then maybe the orange goop is melting."

She laughed. An attractive laugh, a mezzo-soprano fugue, it triggered an automatic assess-the-competition exercise. Roger—elegantly tall, with dramatic pale skin and dark hair—was not in the market for women. Thaddeus had a Mrs. Cooper. But Ben Glaze was single and an impressively brawny man. Ben could have been a football player. I, on the other hand, had the compact build of a male gymnast. Which, in point of fact, I used to be, in college. If Tam went for Ben's kind of physique, I would be way out of luck. On the other hand....

Here was a welcome preoccupation to edge out the bigger, badder, loose-baggy-monster worries about life, art and theft. So I took testosterone up on its suggestion. I leaned closer to whisper, *sotto voce*, "It's supposed to slowly melt because it's a statement about deconstruction."

Tam laughed. "It's not melting. There's a motor inside it."

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She was beautiful—a tall, brown-eyed blonde in a red dress. I could feel wine going to my head and libido going to other places.

The mixed media's perpetrator interrupted my efforts at courtship. Roger announced to everyone in the gallery, "My friends, it's almost time for this opening to close. Drink up!"

Having seen to it that the white wine, which was considering turning to vinegar, had been killed off, Roger ushered everybody out. He let Annika's cat, Triptych, out of the back room to have the run of the place. I noticed that Roger locked the gallery's front door with care, testing it with a sharp tug.

A few of us, including Tam, adjourned to the café across the street. We took a table by the plate glass window. The darkened facade on the other side of the street said HART GALLERY in the splash of headlights from the occasional car going by.

As she spooned white froth off her cappuccino, Tam asked, "Why are we sitting here? Are we guarding the gallery?"

"Should we be?" I replied.

Across the table from us sat Ben Glaze with a new friend: the art babe in the blue dress. She was clinging to Ben's arm much as the dress clung to her breasts. Ben seemed dazzled.

Tam said, "I keep trying to figure out what the thefts have in common. What's the why?"

I replied, "You know, there's one more theft to take into account." Having captured everybody's attention, even Ben's, I continued, deadpan, "I read about it in my parents' subdivision newspaper. There was an arts and crafts exhibit in Westwood Mall, from which a collage was stolen. It was a 'Texas' theme piece with dried bluebonnets, barbed wire and sepia photographs in a mesquite wood frame."

Ben snorted like a Texas javelina. "Arts and crap doesn't count!"

"If anybody's low-down enough to be a thief, why should they have good taste in art?" Tam countered. "Is there somebody who'd have a reason to steal all of the pieces that are missing, including the collage?"

The girl on Ben's arm chirped, "Tourists! You know how *undiscriminating* they can be about weird souvenirs. And sometimes they just *take* things without asking. It must be tourists from Romania or somewhere like that." She proceeded to reclaim Ben's undivided attention by snuggling his brawny arm into her blue-sheathed bosom.

I asked Tam, "Are you worried?"

"That would be paranoid." Cradling the cappuccino cup in her hands, she sighed. "You have to be able to sell art, or give it away, or throw it away when it isn't any good. But one of the pieces over there means a lot to me."

"'Technology Number 7'?"

She nodded. "'Tech 7' is the best in the series. And it took a long time to do, to get just right. I feel invested in it."

Ben's new girlfriend caused him to lose whatever interest he had in guard duty. They left. Which was fine by me. "I get invested too," I confided. "It takes me hours to photograph and sketch buildings from different angles in order to understand them well

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enough to paint them."

"I make friends with scientists and engineers and watch them use their instruments and equipment in the lab. It wasn't until I went and watched a scientific glassblower at Rice University that I understood the beaker and the crucible in 'Tech 7' well enough to paint them."

"Good, because art should be truth about the world. It's not just about my feelings, what I feel. It's about what I see." There was Michael Martin's philosophy and highest aspiration, tucked into a nutshell.

"I believe that, too." She looked into my eyes.

The evening, while not young, wasn't all that old. And the café was cozily romantic. I ventured, "Is your name Tamara?"

"On my birth certificate it's Tammy Ruth Adkins, born in Union Springs, Alabama. But I don't want to be called Tammy or Ruth either one." I recognized the Southern accent in her voice with a thrill, as though I had made a rare and wonderful discovery.

A ring-and-bracelet-bedecked hand clapped my shoulder. Startled, I nearly jumped out of the booth before a familiar, throaty alto voice said, "I thought I'd find some of you hanging around in here."

With irritation, I looked up at Annika Hart, whose timing could have been infinitely better. "Hi."

"How was the opening? Did Roger get everything set up in time?"

"Yeah, but why did you let Roger put that Mixed Media of his in an otherwise outstanding show?"

"It's not Roger's," said Tam. "Roger and I decided Thaddeus did it. It symbolizes anonymous, black urban vigor—the resurrection of the crap of the city."

"But it isn't Thaddeus's." I frowned. "He and I were talking about it behind Roger's back."

"What Mixed Media?" Annika asked.

I said, "The one in the corner where the bad light made it look better."

"I know about the bad lighting. I don't display anything important in that corner," said Annika.

"Whose is it really?" Tam asked. "How does it work?"

"What do you mean, it works?" said Annika.

"You have to watch for a while. Some parts slide around relative to each other, in a way that isn't a simple motor. Michael, I was showing you that just before Roger closed up the opening. I've never seen an art show with a motorized thingie in it. Is that a trend in Houston?"

Annika said emphatically, "No, and I would not display a motorized thingie in my gallery."

Slightly laced with alcohol and caffeine and in a suddenly unsettled mood, I said, "It's there. Let us in and we'll show you."

Annika cleared her throat. "All right. The reputation of my establishment is at stake." Barging out of the café in front of us, Annika declared, "If somebody whom I did not invite to this show has left a calling card behind my back, in the form of a motorized thingie like a tacky display in a Christmas window—out in the trash it goes!"

The warm night air wrapped a

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around us like velvet, reminding me that in the summer in Houston the time to be outdoors, and romantic, is at night. The problem was that in this end of downtown, as late as it was by then, there's no night life. The café we'd just stepped out of was the only business open for blocks around.

With a rattle of keys Annika opened the glass door of her gallery. Whereupon, her cat streaked out.

"Oh, no! Trippy, come back!" Annika called after the fleeing cat.

Triptych is the complacent type of cat. It's a bad sign when a cat like that spooks. I stepped past Annika into the gallery and, holding the glass door open, turned on the lights.

Incandescent brightness burned the scene into my retinas. Tam's painting, "Tech 7," was out of place. Mixed Media was out of place too. To be exact, the painting seemed to be stuck onto the side of Mixed Media as if glued onto the mess—the whole of which scooted across the hardwood floor. It made a beeline toward me. I stood holding the door ajar with my mouth wide open.

The anodized aluminum frame of "Tech 7" hit my shin as it was propelled past my legs. I nearly tripped, but caught myself on the door handle. With a clink as the frame glanced off the door jamb, Mixed Media and "Tech 7" were out the door. Tam let out a startled yelp.

The art sped away on the sidewalk. The configuration had changed. With Tam's painting balanced on top like a graduation cap and mortar, Mixed Media disappeared around the corner.

The idea of a robot art thief dawned on my otherwise blank mind. This had to be an unholy practical joke, centered in the Mobile Robotics Lab at Rice University. Annika emitted a choked sound. Of the three of us, Tam was the first to shake off total bewilderment. "That's my work!" she yelled, and gave chase like a sprinter out of the starting blocks.

"What the hell!" Annika sputtered.

"You look for your cat and we'll get the piece back." I took off after Tam.

With flat shoes and long legs, Tam moved fast. Two blocks down the side street and around another corner, I caught up with her. She had trapped the fugitive in the recess of a store front. The scene was bizarre: a lovely woman confronting a ball of clutter crowned by a painting.

Her Southern accent and attitude were out in force. "Give me my work back, you sorry lil' whatever you are!" She grabbed her painting by the frame. Mixed Media hung on somehow—as if the painting were glued onto it. With a hard shake Tam freed "Tech 7." And then Mixed Media made a noise, a thin rattle like aluminum drink cans hitting the recycling bin.

"Don't you dare cuss at me!" Tam snapped.

Taking Tam by the elbow, I said urgently, "Let's go back to the gallery." I expected a van to screech up beside us and wild-eyed graduate students to jump out bent on retrieving their robot, plus or minus snatching the painting while they were at it.

To my consternation, Mixed Media followed us.

Out of the gallery context it didn't look like art at all, just random debris

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coating a mass which disconcertingly changed shape all over at the same time, bloblike with various undulations. "That is one hell of a robot art thief," I muttered.

"It has pseudopods. That's how it walks." Tam's voice sounded constricted. "I don't know of any machines like that."

"It's not a little robot?"

"Michael, no way!"

In the humidity of the summer night, I sweated. Part of my sweat was sudden, sour nerves. I was acutely aware of how deserted this street was—buildings closed, blank, untenanted—as I watched that thing over my shoulder, following us like a coagulated shadow. Then it hit me. "Out of the mouths of babes!" I whispered.

"What baby?" She sounded tense.

"Ben's friend. Remember what she said about the bad habits of tourists? Just not from Romania. From a lot further away," I blurted. The city of Houston seemed to spin dizzily around me as that thought hit the fan of my mental processes.

Quick on the uptake, Tam gasped. "You think it's alien?"

We hastily backed around the corner. Mixed Media scuttled after us on a ripple of pseudopods. A streetlight's glare reflected in three orbs of green shimmer. "With three eyes, you think it's not?" I demanded, gruff with alarm.

Tam snatched up a garbage can lid from a receptacle stationed beside a bolted-shut door. "Scram, you dev'lish critter!" She hurled the lid.

Mixed Media dodged the lid by rolling to one side with a sudden short wobble like a cube of Jell-O falling off a dessert plate. Then it resumed following us, undeterred.

Near the garbage can lay a discarded push broom. The business end was ratty, but the stick was long and intact. "Aha!" I darted over to grab the broom.

Mixed Media Jell-Oed toward Tam, who let out a little shriek and jumped back. I rushed at MM brandishing the stick end of the broom. "For your next party trick, how'd you like to resemble meatball on a toothpick!?"

It backed off with a disagreeable crunching noise like when you step on a tin can before recycling.

"Ha!" I crowed.

But it kept trailing after us, just out of skewer range.

I thought about the café, with people in it, and Annika standing on the sidewalk with her cat in her arms, anxiously looking for our return, a short, familiar figure. Such safety was still at least a block up the street and around one more corner. I muttered savagely, "Things like this are supposed to show up in Socorro, New Mexico. Not Houston."

"Maybe it needs heat and humidity both," said Tam. "Like slugs and slime mold do."

"Figures!" I was warily half-turned toward Mixed Media. We started to pass an alley. Out of the corner of my eye I caught blurred motion inside the alley. I snagged Tam's elbow and hauled her to a halt.

Things poured out of the alley. With a startled cry, Tam crowded against me. The things arrayed themselves

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across the sidewalk in our way.

Confronting us were three blobs just like Mixed Media. But bigger. Badder-looking. *"Oh, shit,"* I whispered. "It's got friends!" Tam and I clutched each other.

The one right in front of us was not only three times bigger than Mixed Media, it was three times uglier, encrusted with debris that looked and smelled like the dregs of a garbage dumpster. The broken end of a fluorescent light tube stuck to it. So did a battered hubcap.

And it had a tentacle that waved toward us in the air. The tentacle snatched the push broom out of my hands, then tossed the broom into the alley with a clatter. Then, the hovering tip of the tentacle pointed at "Tech 7," with the precise indicative motion of an index finger.

Tam embraced her painting tighter. I understood. But feeling empty-handed and defenseless, I hissed, *"Let them have it before they fry us to get it!"*

She extended "Tech 7." The tentacle curled around the painting in a flash of motion, jerked it from her hands. To my horrified fascination, a pocket about three feet wide opened up in the blob's crust of debris. Like the pouch of a giant kangaroo without legs or paws or head. "Tech 7" was deposited into the pocket.

Tam swore in a low tone of utter malice. Behind our heels, Mixed Media rattled gleefully.

I expected the big garbage ball to be satisfied with its extortion. I wanted the aliens to crawl off and let us go back to the café and Annika.

Instead, they started to advance on Tam and me.

The adrenaline in my system ignited. Whirling, I grabbed Tam's hand and pulled her with me, jumping over Mixed Media and bolting down the street.

When I shot a glance over my shoulder, my heart nearly stopped in mid-systole. "They're coming!"

"But I gave it to them!" she panted, gripping my hand harder. "What more do they want?"

And that was when it dawned on me that unscrupulous alien art collectors might just decide to collect an artist or two. I didn't waste time and breath explaining. *"Run!"*

We pounded down the deserted street's sidewalk. The side streets and alleyways were dim, hemmed by office buildings. Dumpsters sitting in the dimness looked ominous to my frantic imagination—the dumpsters seemed more like angular machines with great big hatches, the use-battered landing craft of an alien invasion.

In fractured glimpses over my shoulder, I saw how the alien things moved by rolling gelatinously, like predatory Jell-O cubes. That way they covered ground fast. And gained on us.

"Where can we go?" Tam took in a sharp breath. "Nothing's open!"

She was right. They were chasing us away from the café. Now we were near Main Street, nothing there but office buildings. I breathed hard, my side and my heels starting to hurt.

We veered around a corner, the locked front door of a fast food restau-

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rant. The things rounded the restaurant behind us, rolling out into the street in wide turns as if their locomotion wasn't much good for tight maneuvers.

And that gave me a sudden hope. Maybe they couldn't jump any better than they could make a tight turn.

"This way!" I towed Tam down Main Street. The glass tower of 912 Main reared up against the sky. Next to it stood the stone bulk of the old Lamar Building. I'd studied that one only a month ago for my "Lamar Building in 1926" and I knew ten times more details than had gone into the painting. Including, the fire escape.

The Lamar Building had a fire escape retrofitted onto the outside wall. It was the kind of contraption that hangs overhead until somebody runs down it and their weight takes it to the ground. Sprinting the last ten yards, I bounded off the wall to get high enough to grab the lowest rung of the escape, which came down with a rusty and reluctant creak. Tam got the idea and boarded with a flying leap. I followed right behind her. We galloped up to the second floor landing.

Without our weight on the bottom end, the counterweights raised the fire escape back into its normal position. A metallic groan announced that the drawbridge was up. I stopped. "I don't think they can jump. We'll be safe here," I explained, gasping for breath and wiping sweat out of my eyes.

She turned toward me. "Did you see? It ate my painting! I hope it gets indigestion!" Furious and breathing hard, with her whole body alerted tense, her beauty suddenly struck me, an effect as powerful as it was untimely.

"I don't think it ate it. It has a pocket like a kangaroo," I murmured. "Keep an eye on them." I tore my attention away from her and looked up to figure out what to do next.

The fire escape terminated at a window on the corner of the top floor of the Lamar Building. I hoped that window wasn't locked on the inside. It gave me the creeps to think about having to perch on the fire escape all night with the aliens prowling on the sidewalk below.

Besides the possibly-locked window at the top of the fire escape, there was another window not too far away. Like all of the top-floor windows on the Lamar Building, it had a decorative, eccentric, 1920s ledge: wider than the window itself, with a fretted rim, nice and deep. And inviting.

Even though the intervening drop was seriously dangerous—five stories straight down to the street—fire escape to adjacent window-ledge constituted an easy jump for me or for a girl with long legs. And *that* window should be unlocked—why lock or seal a window that nobody can easily get to from the outside?

I leaned against the stone wall that our fire escape was attached to. The Lamar Building's bumpy limestone blocks still felt warm from the heat of the day. The giant glass spar across the street at 912 Main gleamed, darkly unsympathetic, but the Lamar Building would help us, give us refuge.

"They have a language," Tam whispered.

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The sound effects ranged from Mixed Media's aluminum-can clinks to noises like shooter marbles in a coffee can coming from its companions.

rattlerattlerattle

RATTLE!RATTLE!

Ratatattle, tatrattle!

Each seemed to wait for a pause in the other's rattle-racket before it started up. Definitely conversing.

From our vantage point, the group of aliens reminded me of the mobilized contents of a dumpster. Broken fluorescent tube, bent hubcap, empty cans, scraps of cardboard. "They're like carrier snails or something," I whispered. "They've picked up trash for camouflage. It sticks in the goop they're covered with."

"Maybe the goop is their space suits or flight suits?"

The comparison of orange gasket goop to space suits gave me cognitive dissonance. But not for long. Tam gasped, "Look!"

The garbage balls were making a stack out of themselves. One-two-three high. The stack reared up, with short thin pseudopods at the top end waving for contact with the fire escape. "Up!" I ordered.

The fire escape squealed ominously. Dismayed, I glanced back to see the aliens in stack formation mounting it, vividly and unpleasantly reminiscent of an enormous centipede.

Clatter rang out. It sounded like empty cans and bent hubcaps clanking on metal. A bottle broke. The aliens were rushing up the fire escape, whacking the steel stairs and guard rails with their crusts of trash.

Cursing under my breath, I crowded Tam's heels climbing the steps. I wanted the things to get me if they got anybody. But I didn't want them to get me either.

At the fifth-floor landing, the top, the window was locked. I'd half expected that. With nowhere to go but that deep-silled window five feet away. I pointed. "Jump to there!"

Peering over the guardrail, Tam reacted to the long drop to the street below. "Ee-yow!"

I gestured toward the commotion of the things just one floor below us. Convinced, Tam climbed over the guardrail like a cat over a fence. She poised herself, then made it to the big window ledge in one clean jump—landing in a bunch of roosting pigeons. The birds fluttered away in all directions.

I clambered over the rail after her. Just as I tensed to launch myself, something looped around my left ankle. I lost my balance and fell.

Tam screamed, *"Michael!"*

I belly-flopped against the stones of the Lamar Building. Bruised and jarred, I dangled upside down with nothing between me and the street five stories down but flapping pigeons and empty air.

One of the aliens had seized my ankle.

The hold around my ankle felt slippery. The tentacle was losing its grip. Sagging a few inches, I frantically pushed up against the rough old stones. Loose change fell out of my pockets and tinged on the stones on the way down.

All four aliens rattled at once.

They say your life passes in front of

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your eyes when you're about to die. All I got was a flashback to a Boy Scout trip on Galveston Bay. One kid had hooked a shark, and the small sailboat rocked wildly. The kid yelled, *Where's the net?* Other boys shrieked back, *Let it go before it pulls you in!* and, *Cut the line, stupid!*

I gripped those bumpy old stones with my fingers and scrabbled with my knees and the toe of my free foot. That way I inched my torso up toward the window ledge where Tam was kneeling, reaching for me.

I got my fingers onto the ledge and its fretted rim. Tam flung herself down onto the ledge, reached over the edge, and grabbed me by the belt.

The tentacle unwrapped from my ankle and let it go. The liberated leg skidded down the wall. I almost lost my grip on the ledge. Tam let out a short scream, but she held on to my belt.

With Tam helping to haul me up, I crawled onto the ledge. My arms and legs shook like bags full of rubber bands. I flopped into a puddle of pigeon-polluted water—rain left over from the last thunderstorm, contained by the rim of the ledge.

Over on the fire escape landing, the aliens concatenated.

Aw, it got away!

Better to let it go than fall in!

I wish I'd had a net!

Tam tried to open the window.

It didn't budge.

I tried. I used all my strength. "Damn! I don't believe this!" It was locked.

Tam banged on the glass. I thought she meant to break it. But old plate glass can be pretty tough.

On the fire escape, Mixed Media jiggled as if doing a dance. It waved something that it held up by its very own little tentacle. "My shoe!" I glared, distracted from the locked window by outrage. "It's got one of my Italian loafers!"

With a startling rasp, the window behind us opened. Tam seized me by the shoulders and flung us both backward. Grazing a knobby radiator, we fell in a bruised tangle onto a linoleum hallway floor and the toes of a uniformed security guard.

Tam scrambled to her feet. I sprang up too, so wobbly that I had to prop myself on the window sill. We stared out at the fire escape, but it was empty. And all we could hear was a faint and dwindling clatter.

"Now, what in the heck were you two doing out there?" asked the security guard, a determined-looking old guy whose hand hovered in the vicinity of his pistol holster.

Tam and I assessed each other. Her hair was in disarray, her dress wet and littered with feathers. Damp from head to toe, I smelled like a pigeon coop. My shirttail hung out of my slacks. I self-consciously wiggled the toes of my loaferless left foot and drew a complete blank on what to say.

Tam drew in a breath, like a pitcher winding up, and let fly. "There was a gang of hoodlums after us!! They snatched my purse—" What purse? I thought distractedly. I hadn't seen one on her all night. Then I noticed that the pocket of her dress discretely bulged with essentials. "And they meant to do something bad to us

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both, so we ran up the fire escape to get away, but they ran after us all the way to the top and we couldn't get in through that window so we jumped over to here!"

The guard's face furrowed in an expression of skeptical, laborious thought.

"I sure am glad I saw you down the hall and you heard me pounding on the glass, or I don't know how on Earth we'd have gotten away from them!"

"That's right!" I seconded with fervor.

We must have convinced him. "The streets are getting meaner every day," he said, shaking his head, and escorted us to the first floor.

As we rode down in the elevator, Tam caught my eye and told me, "You were wonderful! You are just like a brave, pretty little bantam rooster."

"Is that good?" I asked, just as the elevator opened onto the first floor, stopping several inches below floor level, and I exited, tripping on the unexpected difference.

She held on longer than she had to just to help me get my balance back. "It's very good."

At the security desk on the first floor, I called Annika at the gallery. She sped over and gathered us into her Volvo, shocked at our dishevelment.

Back in her apartment in the second story over the art gallery, Annika gave us peppermint tea and, equally soothing, credibility: she believed us. But she added, "I hope you two realize that I'm the only one who will. I did see the thing carry away the painting. The nerve! Hiding in my gallery camouflaged as bad art! I bet it was waiting for its confederates to arrive and force the front door open."

"Instead, I let it get out with the painting," I said ruefully, meeting Tam's brooding brown eyes. "I'm sorry."

"I don't blame *you* for what happened," Tam said. "Annika, don't you think anyone else at all would believe us? Artists? Cops? The mayor?"

"Not a chance, hon," said Annika.

Triptych stood in Annika's lap. The cat purred raggedly, still unnerved, with tail hairs all standing at attention.

I knew how the cat felt. "Let's just hope the aliens don't show up again to steal something. Or—" I added with a retroactive shudder, "—somebody!"

"I don't think you have too much to worry about," Annika tried to reassure me. "They don't sound too smart, they've got no taste in art, and what do they know about this world?"

"Their taste is getting better," Tam said dejectedly.

I thought about her wondrous "Tech 7" and its exact depiction of the high points of high technology, and the way—with even more accuracy, just on a different plane—it summed up the artifacts as a portrait of a human being. Then I realized that "Tech 7" might tell aliens more than I wanted them to know about our world and our humanity.

I park my brush in its glass of water before the acrylic paint on the bristles can dry. Stepping back from the canvas, then up close again, I study the new painting.

Above the city, the night sky is faint-

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ly washed with light and speckled with the few brightest stars. A glass skyscraper lifts its beveled crown into the sky. One facet of the tower gleams, reflecting the sodium glare of streetlights from below. Another side of the huge structure is shadowed, darker than the sky, black. The black isn't uniform pigment and it convinces the eye precisely because it isn't. There are other colors mixed in, tinges of red, green, and purple, so the effect is blacker than monochromatic black.

Art should be truth. For example: the feeling of dread is very much like painting black. Dire, this-is-it-for-me dread isn't a solid black feeling, because it's laced with other emotions—red anger, green nausea, purple absurdity that complete the awfulness. I didn't understand that before but I do now.

Working with nervous energy, I touch the dark side of the skyscraper with the tip of my brush, adding points of titanium-white paint, like reflected stars. The long, narrow configuration of the misplaced constellation suggests downward motion. An ominous intrusion....

I can tell when my pieces are done, as final and perfect as they are ever going to be, when a title pops into my head. Standing in front of my painting, spattered with bits of acrylic, I feel a grin unfurl across my face as I admire the finished work, "Threat of Stars at 912 Main."

I realize I'd better come out of the creative trance and check the time. Sure enough, my paint-speckled watch says Tam will soon arrive with the carry-out Thai we agreed on earlier. I am achingly tired—I worked for nine hours on the painting today—and I'm hungry. And eager.

For the past week, Tam and I have been watching out for each other. Just in case the aliens decide to pick up where they left off. We haven't had any problems with them so far, but we hear that a piece is missing from the student art show at the University of Houston. So we're not letting our guard down yet. Tam and I plan to have supper here in my studio, and then we'll guard each other all night tonight. ■

> Morally, socially, and economically [17th Century] France was a cesspool of corruption. Yet it survived and became even more corrupt. Humanity is unbeatable.
>
> —Eric Temple Bell

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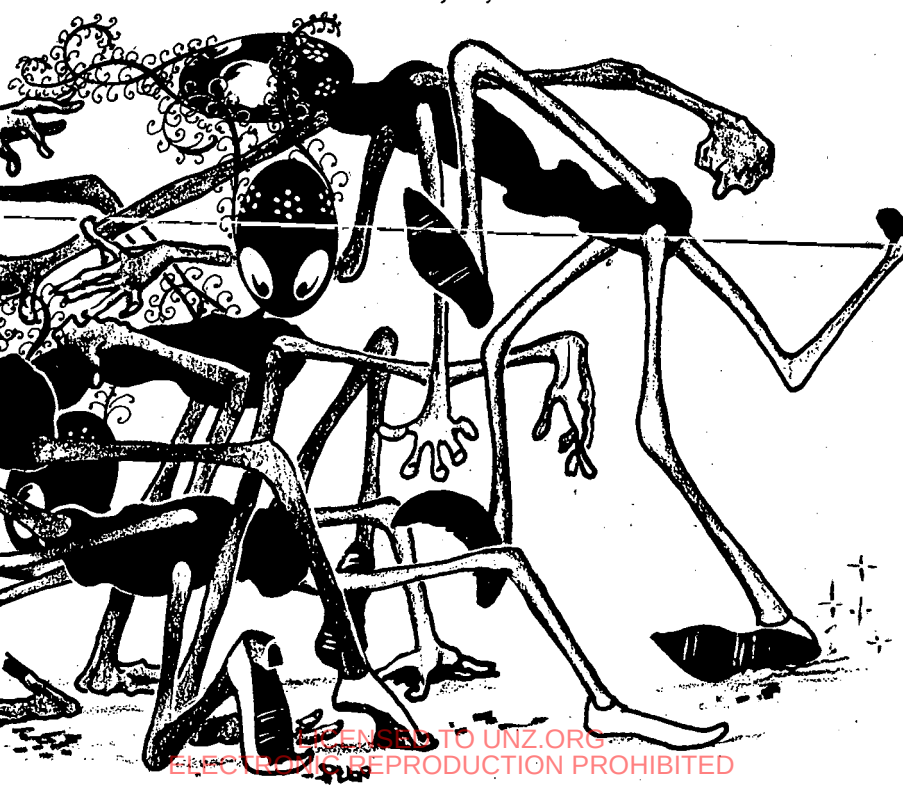
Bud Sparhawk

SAM BOONE'S APPEAL TO COMMON SCENTS

The principles of diplomacy may be, in some sense, universal. But the practice. . . !

Illustration by Kelly Freas



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The acrid smell of the morning wake-up call pulled Sam Boone from a deep sleep. For a second only, the bitter smell reminded him of the mornings he had enjoyed a coffee and croissant at the *Place Mal du Blanc* in romantic New Orleans, back on Earth. He sighed, memories of mercurial Mimi and intense Ingrid lingered a moment at the fringes of his mind, the gentle caress of their hands on his. . . .

Abruptly Sam came fully awake as a cadre of Scrofulosans crawled unheedingly across his chest, some occasionally brushing his face with their feathery antennae in curiosity. Sam rolled out of the path of the marching aliens and began untangling himself from his makeshift bed, a mismatched arrangement he had assembled from his kit to soften the floor of the passageway where he'd slept.

The silence of the aliens' passage was broken only by the chitinous clicking of the Scrofulosans' limbs rubbing against one another and scrabbling against the hard floor. Sam knew that their apparent silence was an illusion, since the Scrofulosans were constantly babbling on and on about the things that mattered most to them; religion, food, prayer, food, and what Halene/ether-four inhaled from Brimstone/whiff-of-sulfide the other night. The rank scent of their discussions wafted over him like the redolent stink of an open cesspool. How had he ever let Ahbbbb, his Pequodista agent, talk him into taking this stinking assignment?

"Hmmmm mmm mmmmbmmm," Ahbbbb had hummed to him, the wormlike appendages on her head beating the sounds on the inflated membranes at her neck. "An easy job, one you can wrap up in a few days. It's just a simple dispute over land rights, nothing complicated." That was just before she stuffed him onto a small Earth freighter at StarPort One, Earth's interstellar commerce hub.

The starport hardly lived up to its prestigious name since it was only used by the few departing humans outbound on one of Earth's tiny ships. Most of the arriving Galactics simply parked their ships in orbit and flitted down to the principal tourist attractions by themselves, ignoring the costly, overly engineered, and woefully inadequate StarPort One, which didn't even have a decent phloomb generator, for heaven's sake!

Interstellar tourism was the primary source of Earth's extra-solar revenues, which is to say *hard* Glax currency. Aliens came from throughout the Galaxy to see the wondrous sights that Earth had to offer, places incomparable to any other in the civilized Universe. Disneyland, Hoboken, and Kawasaki's Sushi Bar and Ribs were the most sought after sights, although, it was reported by some of Earth's returning traders, many of the Galactics were not keen on their young being exposed to such bad art, gross pornography, and wasteful pleasures as these three attractions. Which of the three had which attribute attached to it was still being argued extensively throughout the globe. Questioning the Galactics directly did no good whatsoever; most of the visiting

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aliens were unwilling to discuss humanity's pointed questions on the matter. Some even blushed.

Nothing else on Earth seemed to attract the aliens in such numbers as these three famous/infamous sites. The exceptions were the few extraterrestrial scholars who apparently enjoyed going through Earth's remaining bookstores, taking great and obvious delight in discovering back issues of *Home Beautiful*, *Pipefitters' Monthly*, and *Hustler*. "Two percent," they offered for every issue they could find and plunked down hard-edged Glax credits, more than enough to buy a shipment of the galactic technology that Earth desperately wanted. Even though no one had really understood what the "2 percent" meant they nevertheless accepted the offers as the scholars went off, clutching their purchases tightly in their various appendages.

Eventually boatloads of Glax currency started arriving, 2-percent royalty payments for the magazines which, Earth eventually learned, were the funniest things the galactic community had read in centuries—a record-busting mega-hit on every planet where they were shown! Booksellers around the world dug up every copy of every magazine they could find and began marketing them in earnest.

The fad for exotic literature paled after a few years, replaced by an avid and unaccountable interest in Reywas terminals, an Adanac novelty. In the meantime, humanity had discovered that they possessed certain skills much sought after by the Galactics: certain humans were seemingly able to craft agreements with a skill that left the alien races both amazed and astounded. As a result, there was a constant demand for those who had the vast knowledge and specialized training required, people who could face a host of strange beings without trembling and fear, and who would venture to far places. Sam Boone counted himself lucky to be among that tiny fraction of humanity who were chosen, even if his qualifications may have been more than somewhat dubious.

His claustrophobic time on the cramped Earth freighter, which was carrying a few thousand copies of *Boy's Life* and a dozen gross of "NudieVue" swizzle sticks to a prospective client a few light-years away, was mercifully short. As soon as they reached the first extra-solar transfer station, Sam had been hustled to a Phlegmatian vessel of indeterminate age and, judging by its slapdash appearance, doubtful reliability. Sam climbed aboard with grave misgivings—there really wasn't any option.

The Phlegmatians turned out to be a crew of scaly, horn-nosed creatures whose main pastime seemed to involve staring at each other for hours at a time, occasionally flicking their tongues. Sam theorized that the tongue-flicking was done solely to indicate that they were still alive, since they were otherwise immobile.

On alternative nights, the crew would project large holograms of other, scaly, horn-nosed Phlegmatians sitting around staring at each other. After a mercifully few hours of each such pointless dramatization, the

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show would be over and the projector shut off. Afterwards, the crew hissed at each other—Sssss ssst sss—"Wonderful depth," his translator had interpreted their alien voices. "Quite rococo," another would suggest, "although lacking traditional values." Once, during a particularly long and immobile performance, a ripple of sibilant hisses ran through the crew, even before the show was over; "Innovative," "Subtly sublime," and "A post-aesthetic wonder." Such was the exciting, glamorous thrill of galactic travel.

He managed to endure the five miserable weeks of staring and tongue-flicking and listening to the crew's endless analyses of various shows involving other, equally immobile lizards, before he'd reached Scrofulous Five. "Thank God that that's over," he remarked as he pulled his kit together and made his way out of the vessel, thinking that nothing, nothing could be worse. He decided that he would have to insist that Ahbbbb book him only on luxury ships in the future instead of traveling on the cheap ships.

As he stepped from the hatch the stench of the Scrofulosan station nearly overpowered him. It smelled like a ripe garbage pit, overlaid with the delicate aroma of industrial waste. At first he thought that, perhaps, there was a problem with the atmospheric systems. But no, none of the hundreds of small, one meter tall, stick-like aliens seemed to be racing about in panic, nor did their jerky actions indicate that they were particularly alarmed, although how one could tell where aliens were concerned was ever in doubt.

One of the Scrofulosans crawled from the milling crowd and stopped before him, silently staring up through its three simple and two compound eyes. Some of its teeming companions crawled unheedingly over it as they hastened on their errands. Sam rocked back on his heels from the powerful septic smell that emanated from the creature. No sooner had his nose recovered than the alien squirted a second wave of rank mist.

Sam checked his universal translator to see if it was working properly. The device was the absolute cutting edge of linguistic technology. It automatically translated hundreds of languages into standard Glax, providing flawless two-way translations of human languages into Glax, with only a single exposure to a native speaker, with amazing ease. Ahbbbb had managed to obtain one for him at considerable cost, a price he was quite willing to pay back out of his earnings as negotiator. If this job went well he'd only owe her another two million before it would be entirely his.

Unfortunately, it didn't seem to work at all that well with the few aliens he'd encountered. While the translations were somewhat understandable, they tended to sound like pidgin Glax. Still, it was a wonderful device, without which he would be unable to function.

Even though both of the translator's arms were stiff, which meant that it was drawing power from the local phloomb generator, no sound was

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coming through his earpiece. He gave the translator a sharp thump, hoping to jiggle something inside. He cranked the volume control as far as it would go, for the Scrofulosan was obviously trying to communicate with him and he could hear nothing.

S-sssss- ssss-ss. Ss's ssss s! hissed one of the Phlegmatians who was staring at him from a nearby wall; "Help not. Here is Odor-eaters," the translator blurted too loudly, nearly deafening Sam. Sam puzzled at his erstwhile crewmate's words for a few seconds before it dawned on him that these Scrofulosans must communicate by smell—that was why the station reeked to high heaven! The pervasive smell must be their equivalent of a crowd's hubbub!

The Scrofulosan apparently had given up on getting a response and motioned with one of its eight limbs for Sam to follow. He picked up his kit, flicked his inadequate tongue at the still-staring Phlegmatian, and followed his alien escort.

Moments later, Sam was aboard a shuttle headed for the surface of Scrofulous Five. The small shuttle was crammed to capacity with Scrofulosans who apparently took no notice of who was crawling over whom, or whose foot was in which eye. Sam tried to hold his breath the entire trip. The shuttle was even more malodorous than the station.

Scrofulous Five turned out to be a fetid and overheated planet redolent of swamp gas and other scents the human nose had not evolved to endure. But there was little time to study the depressingly foggy view from the landing grid as his escort whisked him into a tunnel that led to an underground warren. Along the way they passed an endless stream of other Scrofulosans, crawling over one another as they scurried on their busy errands. Sam hadn't seen so much frenetic activity since he kicked an anthill.

Eventually Sam's escort led him into a chamber where they joined a larger group. There were at least a dozen of them. The Scrofulosans' bodies were so alike that Sam could discern not a hairsbreadth of difference between them.

In their midst stood an assembly of tubes and pipes, canisters and tanks, switches and valves that looked like a not-so-miniature, haphazardly-constructed chemical factory. Hanging from one arm of the complicated device was an earpiece similar to the one on his translator.

A small creature hopped around the device like a cricket on speed, its appendages flicking switches, turning knobs, adjusting valves, and, in general, looking like a one-alien-band. Clii—ccc-kkk, clickedy-click, it chirped as Sam's translator converted it to Glax. "About time got you hire, mud-person. Attend the high gloss."

"I don't understand," Sam replied as his translator produced a series of loud clicks. The tiny creature jerked back and covered the two white patches on its abdomen with its forelimbs.

CLIII-CCK CLICK! the little creature screamed. "SHOUT NOT! Poor soundings wring pleasure from my life."

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Sam surmised that the white patches must be thoracic tympanums, the creature's equivalent of ears. Before he could react, the cricket scurried over and snatched Sam's translator from his shoulder, yanking the earpiece so hard that Sam felt his ear had been detached.

"Hey, watch that!" Sam yelled as the creature opened the translator's casing and stared inside.

Click? Cliiiccccckkk, click-clickedy! the little alien said, and threw Sam's translator onto the ground. It bounced with the sickening sound of broken glass and shattered metal as Sam looked on with horror—that was two million down the tubes! How would he ever replace it? He bent to scrape together the pieces as the tiny alien hopped behind the strange machine. It emerged a moment later with a small silver box no larger than Sam's hand. With a twist of the leads the cricket attached Sam's earpiece to the device and handed it back. Click, click, clickedy, the alien began. Click . . .

Carefully Sam put the earpiece into his ear and heard the translation; " . . . most disgusting piece of Pequodista crap I've ever seen. Why are you using such a museum piece anyway, Earth-thing? Damn thing only handles the audio languages, and only a few hundred of those! Really good for nothing, a child's toy! Is Earth that poor that they have to buy translators that are a Glizzatina a dozen?" A Glizzatina was the lowest denomination of the Galactic currency, whose face value was actually less than the value of the metal used to coin it.

"It's the best I thought I could get," he stammered, and heard his translator chirp a softer response than before. Had Ahbbbb's translator *really* been that worthless?

"Now you are in much better voice," the little alien replied. "More melodic, anyway. Keep the device, Earth-thing; I'd rather not hear the noise that crude monstrosity you brought with you produced. And don't worry about the price, I'll scrape the Scrofulosans' or the Mephitisites' accounts for it."

Sam was amazed at the quality of the new translations and wondered at the honesty of his agent in naming the outlandish price for the worthless "piece of Pequodista crap." Perhaps he should not be so trusting of her in the future? "Thanks," he said.

That done, he pointed at the strange machine in the center of the chamber. "Now, what is this thing?" he asked, "and who are you?"

Cliiii-ck! Clickedy, click . . . the alien responded quickly as it leaped to adjust a valve on the strange device. "Name's Sslovva—senior Rix engineer! I'm with the Scrofulous Five engineering group. We were instructed to build this scent translator for you, since you were reported to have a rather inadequate nose. It converts the pheromonic essences of the Scrofulosans' and the Mephitisites' languages to sounds that you can hear."

Sam warily considered the machine for a moment, taking in the tanks that must contain the bases for the scents, the tubes, nozzles, and various appliances in between. He tentatively placed the machine's earpiece into his other ear as another noisome assault

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of *essence-du-sewer* washed over him.

A string of tinny words in clear, standard Glax came from the translator; "Ugly, evil-smelling, deaf-beast from Earth, the rightful owners of Scrofulous welcome you to the beauty and wonders of their city."

"And the same to you," Sam replied and watched in amazement as the scent translator belched out an aroma of onions and gasoline toward the assembled Scrofulosans.

"I am Chlorine/blend-of-sage, your guide, deaf-beast," the alien who apparently had been his escort wafted. "It is my duty to assist you, to help you in any way in your masterful undertaking."

Sam pointed at the machine. "I guess that I have to use this, er, thing to translate all of the time." He wondered how he would lug the huge thing around. A quick heft indicated that it must weigh at least thirty kilos, and probably a top-heavy thirty at that. He searched for a set of handholds or straps, but found none. Maybe he could have the Rix engineer—what was its name, Sslovva?—install some?

"I'll need help to get this to my quarters," the machine wheezed and belched in response to his Glax.

There was a flurry of consternation among the Scrofulosans. They tangled together in a knot of limbs and torsos amidst a cloud of indescribable effluent too complex to be translated. "What do you mean 'quarters'?" one of them finally wafted back at him.

"It's a place to sleep, to change clothes, to do, er, private things," Sam answered and waited while the machine huffed and puffed the translation.

"You may sleep wherever you wish, like any other civilized being. We are all but hands of the great God, and God does not hide his hands," Chlorine/blend-of-sage suggested. "We have no restrictions on where you might choose to sleep, although, er," the alien coughed a slightly bluish cloud of vapor, "we *would* prefer that you stay out of the main corridors as much as possible so that your ugliness does not disrupt the aesthetics of our city.

"But now we do not understand what you mean by 'private things.' Is this another part of *quarters?*"

"No quarters?" Sam asked plaintively and tried to remember what Ahbbbb had told him about the concept of privacy among the Scrofulosans. Damn, when would he learn to pay attention to her briefings? First the business about communicating by scent and now this. What other surprises were in store?

As he pondered how to explain what he meant by *private things* he heard a low roar in the distance, as if a faucet had been opened. The Scrofulosans turned as one and prostrated themselves on the ground, all facing in the direction of the sound. When the sound had faded away, moments later, the group turned again to Sam. "We are pleased that you have come to help us," one of them whiffed. "It is about time someone put these upstart, alien Mephitisites in their rightful place."

"I agree, most honored Offal/taint-of-mustard," Chlorine/blend-of-sage injected smoothly as it stepped for-

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ward and touched Sam's arm. "It has been a terrible trial for us. Especially after our dear ancestors spent their lives taming this joyful and beautiful environment. Ten generations underwent terrible deprivations to build this wonderful city, enduring hardships beyond measure so that we, their descendants, could enjoy the comforts and beauty that you see around you."

Sam looked around the glowing, dripping, mildew-encrusted walls, the damp floor, and the dank, rough-hewn recesses extending in all directions. "Lovely," he responded dryly.

"It was my great-great-great grandaunt that put down the first scent trail to the God Hole," Offal/taint-of-mustard took up the thread where Chlorine had left off. "And now, that trail is daily dishonored by those horrible, terrible aliens who act as if they have rights to the planet we claimed first." Her diatribe sputtered off in a mist of putrid squirts.

"I will try," Sam responded softly, "but I cannot make any commitments without hearing both sides." Best, he thought, to hear what the Mephitisites had to say. In the meantime, perhaps he could get the Rix, Sslovva, to get the monster translating machine fixed so he could carry it, before the little alien scurried off on another project.

The acrid smell of the morning wake-up call had scarcely faded when Chlorine/blend-of-sage appeared. "Did the deaf-beast rest well?" it puffed as it casually scraped a hunk of slimy growth from the tunnel's wall and stuffed it into its mouth.

"Sure did, nothing I like better than being a doormat for a parade of stinking aliens all night." The translator chugged his reply slowly as Sam pulled on a dry outfit and ran his fingers through his hair. Why the hell should he do more—how would these aliens know the difference anyway since they'd never seen a human before? Who knew, maybe a little body odor would even help. "Let's get the negotiations started," he said as he hefted the awkward scent factory onto his back. "Bring my kit along, would you?"

They hadn't gone more than a few hundred meters when a huge, slimy, slug-like alien approached. It was the first Mephitisite he had seen since arrival. Sam was fascinated at the way the ragged edges of the creature's apron of skin nearest the ground flapped as the huge alien leaped. He could hear a fluttering sound as it drew near. A little cloud of mist blew away to either side with each bound.

Whoosh-phlattttt-blah-blah whoosh, the approaching alien retched as it modulated the air flow. "It is not * to curry ** with the *," Sam's new silver translator interpreted the exhalations smoothly into standard Glax. "* were not notified of the * arrival, * were not told of * needs, * were not given the * to offer the * of wind." The Mephitisite flopped to a halt in front of them, its four feathery antennae waving in circular patterns.

It took a moment for Sam to remember that half of whatever the Mephitisites said was expressed pheromonically and the other half au-

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dibly. He shoved the earpiece of the scent translator into place quickly, so as not to miss any more of the conversation.

"Wretched beast of the damned, defiler of the Universe, I didn't expect you to arrive so early," Chlorine/blend-of-sage exuded angrily, filling the surrounding atmosphere with the rich smell of methane. "I was merely taking this deaf-beast to our meeting place. I was not currying favor."

The Mephitisite rippled the skin-like apron along its side with the sound of tearing cloth. "You *are* carrying its luggage, are you not? I must assume that you are being deliberately subservient, acting as a wretched beast of burden simply to gain some sort of obligation from the Earth-thing." Sam had some momentary disorientation as the translation alternated from ear to ear. *Things* were apparently audible and *actions* and *descriptors* were scent-based. It was an interesting linguistic adaptation.

The Mephitisite sniffed—a mighty inhalation that dried the floor for meters to either side, and turned its (head?) toward Sam. It let out a blast that sounded like a Bronx raspberry and smelled like an elephant house in August. "I am Flatula, the right honorable representative of those Mephitisites who have settled this gorgeous planet," it introduced itself. The thing spoke with such pomposity that Sam imagined, had the alien been a Prussian, it would have clicked its boot heels, had it any heels to click.

"Are you the new Speaker for the Mephitisites, detestable being from the stars?" Chlorine/blend-of-sage reeked a cloud of inquiry. "Is that why you have come?"

Flatula jumped back with a blast of air. "Hardly," it protested. "I merely wanted to ensure that this Earth-thing was familiar with our position in this matter." A long, slender pseudopod extended toward the burden on Sam's back. "If you will permit me," Flatula said as it took the weight of the chemical factory off of Sam's back. "Now, dearest Chlorine/blend-of-sage, we can proceed as equals. We are now *both* beasts of burden."

Since the Mephitisite's grasp of the translator had pulled the earpiece away Sam could not understand Chlorine/blend-of-sage's reply but, judging by the aroma that poisoned the air, it wasn't nice.

At issue, as best as Sam could determine, given the ambiguities and difficulties in converting their aromatic languages to Glax, was that the Scrofulosans stated a prior claim to this planet while the Mephitisites said they had bought settlement rights for their colony fair and square. Both sides contended that the other was being unreasonable.

According to his universal handbook, another item Ahbbbb charged him dearly for, the Mephitisites were well known for sharp trading, planetary redevelopment, and rather catholic palates. Their single, alleged character flaw was an occasional alleged genocide, but, the handbook said in a tiny footnote, only on the outer fringes of the Hegemony, only when no officer of the Court was nearby, and only where proof of what

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they had done was never possible, largely because of the singular lack of living witnesses, particularly among the genocides.

The Scrofulosans were, as Sam began to understand, a prolific species that was obviously as long on dumb as they were short on deodorant. Some of their ancestors had ceded a portion of the planet away to the Mephitisites for a handful of Galactic beads and twenty Glax credits. Their descendants now regretted the bargain and wanted the Mephitisites off their planet.

Through the Rix, Sslovva, he had learned that the Mephitisite delegation also had a rather nasty habit that didn't make the guidebooks. On occasion they would eat one of their number, usually the current Speaker. In between times they simply nibbled on one another. It was a slug thing, the Rix said, he probably wouldn't understand. Sam assumed that their appetites might make continuity of negotiations somewhat difficult—it would be hard for him to establish more than a temporary relationship with a Speaker who was also a potential entree.

Fluthth, the Mephitisite Speaker *du jour,* started the first series of sessions with a lengthy, stomach-turning, and loud belch of redolent gas that would have rattled the windows, had there been any in this underground burrow. Apparently Flatula was one of the more personable, polite, and relatively clean-speaking members of their group. Sam could barely bear to be near the other Mephitisites as they ranted on and on about the rights they had legally purchased, so vile was the smell of their outpourings.

Sslovva, who had appointed itself as Sam's unofficial *aide-de-camp,* would softly explain whatever nuances his complicated machine missed. The Rix, through long association with both races, was able to suggest meanings that Sam's translator could not.

Offal/taint-of-mustard, as leader of the Scrofulosans, would always wait until Fluthth was finished before clicking her mandibles and squirting the haze of chemical mist that explained the Scrofulosan point of view. The windy flatulence of the Mephitisite delegation, combined with the odors produced by the Scrofulosans, usually left the negotiation room smelling like an open sewer.

Sam frequently had to excuse himself to get some fresh air. In the dank Scrofulosan city such "fresh air" was any atmosphere having a hydrogen sulfide and methane concentration somewhat less than lethal to humans, but thankfully absent of the many other unpleasant congeners that made the negotiations so difficult to bear.

"What is wrong?" Sam asked Sslovva during one of the breaks several days later. "You don't seem to be your normal, chipper self today."

Click, Sslovva started to reply slowly. "It is Sslinno, one of the engineers, Earth-Sam. He has been sounding very nice lately. I am starting to think that it is no accident that I find his melody so pleasing."

Sam smiled. Even here in the depths of the galactic, dark love or lust managed to rear its pretty head, or whatev-

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er the local equivalent was. Although how the Rix told each other apart was something he had not determined. As far as he could tell, all of the Rix were alike as peas in a pod. It was, however a surprise to find out that Sslovva was female. "Hey, go for it," he advised with a smile.

"Do you think so?" the Rix replied. "I mean, it is such a dangerous step. I'd hate to be wrong in my assumption. I would like to live out my normal lifespan."

Dangerous? "Why, is your admirer married to someone who might be jealous?" Sam asked. "I mean, flirting is one thing, but messing around with someone who is . . ."

"What is 'married'?" Sslovva interrupted with a puzzled note in its clicking. As Sam painstakingly explained the honored Earthly practice and what it meant, the little Rix began leaping around the corridor, bouncing off the walls at all angles. Clickedy-clickedy. Cl! ICK; "Heh, heh, heh. That is the damnedest thing I have ever heard! Wait until I tell the others about this, they won't believe me! Scatter's children, but you Earth beings are *weird!*"

"If that isn't a problem," Sam continued haughtily, trying to preserve some dignity by ignoring the alien's laughing dance, "then why did you say it was so dangerous?"

Sslovva settled down. "Ah, it is dangerous because I am not completely certain that Sslinno is a male," she responded. "If I make myself vulnerable to his tune and HE is not what HE seems then SHE will kill me."

"Whoa. Why would he, or she, or whatever," he added just to be sure, "make eyes at you otherwise?" Deep inside he wondered if some aliens could be . . . naw, it wasn't possible.

"Is the way we mate," Sslovva responded. "Males attract females by making their melody pleasing. But when we become female we sometimes make our melody pleasing to other females to lure them unknowingly to a vulnerable position where we can attack with deadly force. It reduces the competition."

"But," Sam sputtered, "would someone on your engineering team actually kill you? I mean, isn't that just a tiny bit counterproductive?"

The Rix stood on its back legs and scratched at its thorax. "Do you think so? Hmmm, perhaps I should talk to my teammates about that aspect. Maybe that is why we have become so few in number these past years."

Sam suddenly began to have doubts about the intelligence of this particular race and then shrugged. It didn't matter—after all, they were just engineers. "Well, what are you going to do?" he asked.

"I will do the only sensible thing that I can, Earth-Sam. I will make a male melody pleasing to Sslinno. Then, if SHE responds it is I who will be the victor. I will then have whatever males remain for myself!" The Rix hopped off with a final Clickedy-click; "Thank you for the help, Earth-Sam. Thank you. I will 'go for it!' as you say."

Sam was speechless. Maybe he'd better keep his mouth shut until he learned the customs. No telling what

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trouble he might cause otherwise.

Whooosh-phlaat, ka-blooie; "I despair of ever reaching an agreement with these stupid aliens," Flatula remarked during a breather in the discussions.

Sam had tried to find someplace where he could be by himself for a few moments, a nearly impossible task given the continual and pervasive presence of the Scrofulosans who swarmed everywhere, crawling over each other like ants. Despite that, he did manage to find an alcove where blissful solitude reigned for a few moments, until Flatula entered on a cushion of fetid air.

"There must be some basis for agreement," Sam responded carefully, not certain of which delicate nuances he was missing this far from Sslovva's help. "They will come around, just as you must alter your, er, stance. That is the way that accord is achieved."

"One must be ever careful with these lesser races," the Mephitisite continued. "They are so ignorant of the proper ways of commerce. So poor, too poor to properly treat a frowlzing being such as yourself in the manner appropriate to its taste. I assure you that we would not be so impolite, were we but given the chance."

Sam was astounded. Was Flatula actually trying to bribe him or was he misunderstanding the alien? Perhaps this was merely a plea for equity—to give the Mephitisites an equal chance to house and care for him. Best to steer a politic course. "What do you have in mind?" he asked.

WHOOOSHHHH! "Very gratified that you see things in their proper context frowlzing Earth-thing! Yes, yes. We will have your things moved to our facilities immediately. Tonight you will have your own 'quarters'—quite different from these," the alien snorted loudly, raising a cloud of choking, foul-smelling mist, "dreadful accommodations."

Thank God, Sam thought to himself. It would be nice to be able to go to sleep without worrying about a horde of tiny aliens using you for a rug during the night. It would be nice to have some privacy for a change.

The Scrofulosans were less than enthusiastic when they heard about Sam's forthcoming move. "Have we offended you in some way?" they wafted at him. "Have we been less than gracious in allowing you access to our glorious city? Or have these," there was a dreadful smell that nearly made Sam pass out, it was so foul, "despicable creatures bribed you in some way?"

"I have not been bribed," Sam responded with indignation. "In my position one must remain impartial. I merely feel that both sides should have equal opportunity to extend their complete hospitality."

Offal/taint-of-mustard jerked back, scrambling over four of its fellows in a jittering panic. "We do not want you at risk. We do not want you to be replaced. What if they ask you to dinner?"

This was getting very confusing. He had no idea that etiquette was so important among the Galactics. Perhaps he should ask the little Rix to tell him

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some more about the Mephitisite dining manners. Wouldn't want to pick up the wrong fork or something and embarrass himself, he thought.

The Speaker for the Mephitisites belched angrily when it heard the Scrofulosan's question. "We have no such intentions of aesthetically editing the frowlzing Earth-thing. It will not be invited to dine with us. Besides, it is so scrawny and small—probably tastes terrible, too. Oh, no offense intended," it added in a malodorous aside to Sam.

Or maybe Mephitisite table manners were something he should not be too eager to acquire after all, Sam thought. Where the hell was the Rix anyway? He had to know what he had let himself in for!

When Sslovva arrived a few hours later Sam saw that the tiny alien remained in her blue funk. Her clicks were desultory, hardly any crispness whatever. He suspected that the prospect of a tryst with Sslinno was at the root of her problem.

"Didn't you make the male sounds?" he asked when he had a chance. "Or did you chicken out?"

The little Rix responded carefully. "Things have gotten very bad, friend Earth-Sam. I waited until only Sslinno and I were within speaking range and then did the male melody, as I said I would. I was not prepared for the response—not a bit. Sslinno responded with the most beautiful female melody that I have ever heard. Oh Sam, it nearly broke my hearts to resist that call, it was so lovely."

"Wait a minute," Sam protested. "I thought that you said that you were a female. Then how could you. . . ?"

The Rix chirped sadly; "I thought so too, much to my regret. Now I am not so sure. The response was so lovely to my ears that I think that I must really be a male. It is such an indeterminate thing for us, you know. That is, until it is time."

Sam tried to reason it out. "If Sslinno is really a female and it turns out that you are a male then why not, er, consummate the relationship?"

Every limb of the Rix sagged. Cliiiiiicccccckkkkk, it wailed despondently. "But what if she is really a male making a *female* call to lure me? Our males are equally deadly about reducing the competition."

Sam wondered if Ann Landers ever had this problem. How in the hell did any little Rix get produced if there was this much uncertainty and predation in their mating rituals?

"So what will you do now? Will you go back to the female tune you started with?"

"Alas, but I cannot. That would confuse matters greatly. It seems that we two have carried our courtship too far to go back to where we started. I must weave a strategy that will minimize the risk to myself."

"Why don't you just say the hell with it and walk away? I certainly don't want to lose you just as negotiations seem to be moving forward."

"I cannot stop the courtship, Earth-Sam. I must continue until Sslinno and I have decided what our relationship is to be." Slowly the little creature dragged itself down the corridor to rejoin the dating game with its possibly

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deceptive sweetheart.

The Mephitisite accommodations were certainly different from the open hallways of the Scrofulosans, Sam observed as he took in the slimy walls that pressed so close on either side. The Mephitisites, he had discovered, liked to fit snugly inside their little dens with the walls pressing close against their bodies. The horny carapace that he had noticed on the rear of each served as a door once they were inside, blocking any other access and protecting them.

After showing him to his digs, the Mephitisite took Sam on a brief tour of their burrow. Sam could discern little difference between the array of slimy passages that they followed, nor could he fathom the awe with which they approached a filthy pit of noisome fluids.

"This," Flatula whooshed as a few of its companions gathered at the edge of the pit, "is the only reason that we wish to remain on this abysmal planet." Sam looked at the pit, observing the smooth surface of the brownish fluid. Long moments passed as nothing happened, and then, just as the distant roar of God's Hole could be faintly heard, tiny black spots began to appear on the surface of the pool. To Sam it looked as if an oil leak had sprung somewhere below. One of the spots spread rapidly until it was barely distinguishable from the rest of the surface.

The Mephitisites surrounding the pool were in a flurry of activity as they tried to scoop up the spots before they disappeared. They'd managed to capture only a few precious drops before the spots stopped appearing. Sam took a sniff of one of the containers and jerked back from the revolting stench.

"Whew, why do you bother?" he asked.

"You do not find it pleasant? How strange—you creatures must have a very restricted palate," the Mephitisite responded. "This condiment is our primary export. It is in great demand elsewhere. You have no idea of the exquisite flavor it adds to . . . but I shouldn't bore you with such culinary matters. Let me just say that this tiny bit is the most valuable commodity we have—sufficient to support our settlers—even though we reserve half of the production for ourselves. Now, come, let me show you the slime molds. After that we'll visit the dears in the nursery—and don't worry, we've enough safeguards to protect ourselves."

That evening Sam huddled in his narrow room while the Mephitisites dined. From what he could hear the Mephitisite dinner was a horror of slobbering sounds and airy screams. Sam looked askance at each forkful of the meal they had fixed for him, checking each morsel to make sure that it had no intention of screaming in protest before shoveling it into his mouth. The distant screams had abated by the time he'd finished his meal and were replaced by much more disturbing sucking, slithering sounds from the dining area. With a shudder, he prepared for sleep.

Sslovva had driven pins into the walls to allow Sam to rig a hammock,

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which could serve both as his bed and as storage for his kit. Sam discovered that he couldn't rest easy. He was fearful that some goo-sated Mephitisite would see the unblocked doorway, forget about the tiny human inside, and squeeze in, crushing Sam in the process. Perhaps being a doormat for the Scrofulosans hadn't been so bad after all.

In the morning a new Speaker had been selected. Flatula and other members of the delegation also had a few additional chewed-out notches in their aprons. All appeared somewhat reduced in size.

Sam was very glad he hadn't been invited to dinner.

Offal/taint-of-mustard and the other Scrofulosans stayed behind while the Mephitisites left the room for a private conference after a particularly pungent exchange of arguments.

"We have something for you," Offal/taint-of-mustard exuded softly. Another of the Scrofulosans scurried up and handed the leader a tightly tied bundle. "A small gift, to show our respect for your efforts, deaf-beast."

Sam accepted the bundle from the alien with some trepidation, unsure of whether it would be proper to accept gifts from one side or another. Still, he was intrigued as to what the Scrofulosans would consider a proper "gift" (a.k.a. "a bribe"). Interesting, he mused; perhaps the Mephitisites would do likewise to maintain their perceived position? Avarice suddenly became such a warm, exciting possibility that Sam felt ashamed of himself. He quickly shoved the bundle into his carry-all so that the Mephitisites would not see it when they returned. "Thank you," he whispered.

The afternoon's negotiations achieved nothing except to fill the room with the rotten stench of suspicion.

The Scrofulosan gift was puzzling. Inside the bundle of obscenely smelly rags was an indescribable lump of . . . something that looked as if it were pieces of chewed bark and swamp moss, embedded in what looked suspiciously like odoriferous excrement. Yes, Sam concluded after sniffing at the thing's uneven surface, it even smelled like cow dung! He turned the object over and over, trying to discern what it could possibly be.

Neither Sslovva nor the other Rix were any help. They told him they had glimpsed such objects elsewhere, always in very private Scrofulosan places, but, since they weren't mechanical, the Rix had no curiosity about them.

"Did you like our gift?" Chlorine/blend-of-sage asked shyly the following morning.

"It is very lovely," Sam equivocated. "I appreciate it very much."

"Ah, wonderful," Chlorine answered, obviously pleased with his response. "We were concerned that you would not have the sensitivity to understand. I smell that we underestimated your abilities once again. I can't wait to sniff your every reaction."

"Perhaps when we have some more time," Sam replied, heading toward the negotiation room as he

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swore under his breath. Damn, what *was* that gift? He was going to be terribly embarrassed if he didn't figure it out, and soon.

The day's sessions became especially heated, driving the Mephitisites in a cloud of angry mist. As the Scrofulosans began to respond Flatula whipped out a can from under its skirt, pointed at the Scrofulosans, and sprayed. Sam didn't know what to do—was this some weapon, some deadly virus, some noxious gas? Then a strange sensation overcame him. For the first time in weeks there was no odor to the room. He looked around at the confusion among the Scrofulosans who were gesturing futilely at each other and shaking their appendages at the Mephitisites. "Deodorant," Flatula belched and laughed, "that should teach them to argue!" Whatever it was, it effectively brought the negotiations to a definite halt.

While everyone was waiting for the deodorant to wear off, Sam headed for the local phloomb-driven ansible. It was about time to update Ahbbbb about his progress, or lack of it. When she heard of what had transpired to date her attitude moved up a notch from her normal state of *mild concern* to the more troubling one of *deeply disturbed*. Sam expected that if he didn't wind this assignment up soon, then there was some point in the not too distant future where she would no doubt escalate to the *sheer panic* mode. He had to prevent that. Ahbbbb's response to a panic situation usually meant no end of trouble. He well remembered what had happened when she had become involved in the tense situation between the Kittchiikoostrans and the Sphagers. It had taken weeks for his hair to grow back.

"Not to worry," Sam assured the Pequodista. "I'm positive that once I figure out how to create an environment of trust and mutual respect the issue will resolve itself." Actually, at the rate things were going, he'd be lucky if this didn't escalate into war. "Trust me," he finished, hoping for a miracle.

Ahbbbb's response was less than supportive.

The Scrofulosan gift continued to confound Sam. Perhaps, he thought, Flatula would be able to provide some insight on it. He picked it up by the least repulsive corner and carried it to the common room where the Mephitisites usually assembled for their evening soirees. He intended to be back, secure in his little room, before that gourmand event began.

He was unprepared for Flatula's response when it saw the object.

WHOOSH!WHOOOOOOOOSH; "Remarkable! I had no idea that these insignificant creatures had such resources! No expectation that they shared our interests. Perhaps we have misjudged them entirely. Oh, this is quite breathtaking!"

"Then it has some sort of value?" Sam interrupted the large alien whose exhalations were becoming overpowering. From the way that Flatula was reacting Sam knew that his translator must be missing a lot of the pheromonic intensity of the alien's exclamations.

"Value? Oh, this is absolutely without price. I doubt that I'd have

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enough Glax credit to pay for such a treasure, although, if you are willing to sell. . . ." The Mephitisite delicately suggested as it caressed the lump with its pseudopod while passing its antennae over and around it. "Priceless!" it whispered. "Lovely." Flatula let out a loud WHOOOOSH-WHOOSH. "Frowlzing, definitely frowlzing," it said.

"You can't stay here with this," Flatula suddenly said in a rush as it glanced around. "I am afraid that many of our people might not have the restraint that I have. They might even be driven to do you harm to gain possession. Come with me to my den. We can hide it there, where I can protect it."

From the way the Mephitisite was ogling the object Sam felt less than comfortable about the offer. "I think I will go back to the city," he remarked. "Could you call Sslovva for me?" He had to ask three times before Flatula stopped offering its help and left to make the call. In the meantime, mindful of the warning, he shoved the lump under his jacket.

The haste with which the Rix escorted Sam back to the crowded hallways of the Scrofulosan city made him uneasy. "Never seen a Mephitisite so worked up," the Rix remarked as they trundled the translator along. "Practically slobbering with hunger, if I'm any judge. What did you do; offer him your ugly body?"

"No, I just showed him that damned gift," he replied, and he still hadn't a clue as to what it was.

One evening Chlorine/blend-of-sage sat with Sam near the conference room. The conference room was one of the few places where they were out of the ever-present traffic. Sam had decided that he felt a lot more comfortable being as far as possible away from Flatula for the time being. "That gift of yours," Sam began warily. "It is very lovely."

"So you mentioned before," Chlorine answered. "And I am still interested in learning of your alien perceptions." No help there.

"Quite interesting, too," Sam added, still hoping for some clue.

"Yes, it does have a long history, as you no doubt could observe for yourself. Even your smelling appendage must be able to discern that."

"Of course, very venerable. Anyone can see that."

Chlorine started in surprise. "You said 'venerable'! I had no idea that you had such depths," it exclaimed. "Oh, this is most wonderful. The priests will be pleased when I tell them of this."

Aha! So this thing had some sort of religious significance, Sam thought. "I don't understand how your priests could bear to part with it," he stated, hoping to elicit further disclosures.

"We didn't have to apply much pressure," Chlorine admitted. "When we explained that we had to best any bribe that those hateful Mephitisites might offer, why, they immediately suggested giving you their best. You have no idea how pleased we are that you understand its meaning. We suspected that few heathen aliens had the sensitivity to appreciate such art."

Sam sat up suddenly. Wait a moment, had Chlorine said "art"? What

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the hell was so artistic about a lump of excrement? And what did art have to do with priests? "I hope they are not upset over losing it." Sam probed.

"Oh, they will have one of their artisans create another. It is only the gathering of material that takes so much effort. You must understand how that is."

"Yes," Sam agreed, "so very expensive to collect." What the hell was it? He was getting rather compulsive over the question; out of all proportion, which meant that, down deep, his subconscious must attach some importance to this piece of junk.

The day's negotiations got off to a bad start when Offal insisted that the Mephitisites be frisked for weapons before entering the city. Things went downhill after that and, once again, the negotiations were stalled. Sam decided to ask Sslovva if it could suggest a way around the impasse. Perhaps it knew something that would help. For some reason the little Rix hadn't shown up as usual.

When Sam found Sslovva it was sulking in one of the corridors. Clearly, the Rix was not at her—or was it his?—best. The tiny creature was limping along, as if held down by some great weight. "I take it that the courtship is not progressing well," Sam prompted.

The Rix gave a desolate click. "It is terrible, Earth-Sam. I had hoped that Sslinno and I would reach some sort of resolution, but, alas, that was not to be."

"You still do not know whether you are male or female, whether he or she is a she or a he?"

"Oh, you have such a perfect understanding, Earth-Sam. Would that I had your penetrating intellect. You are right, the issue between us remains unresolved, at least as far as my life is concerned. In other matters I am afraid that resolution is very prominent." The Rix turned about and showed what had emerged from the rear of its thorax.

Sam gasped in surprise. A shaft nearly half the alien's length protruded from the tip of its thorax. It appeared triangular in cross section, with rather sharp-looking, serrated edges. The wicked-looking appendage looked as if it could slice through steel. "What the hell is that?" he exclaimed in wonder. "Are you getting ready to fight or something?"

The Rix turned back to face Sam. "Fight? Would that it were that easy. No, this is what happens when the male in me is awakened. This is the instrument with which I will consummate this affair."

"I guess that you've determined that the object of your affection really is a female. Well, looks like you and Sslinno are going to have a hell of a weekend." Suddenly Sam had a new appreciation of what the Rix had meant by the affair being dangerous if one chose wrong. Of course, he added ruefully, that might be only marginally preferable to choosing *right!*

Click-clickedy-click; "You do not yet understand. I have assumed no such thing. Whether my precious Sslinno is male or female is not in question. Since my body has clearly chosen to

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assume the male role, I must take whatever fate deals me. The biological imperatives are too great to resist. Tonight, the issue between Sslinno and I will be resolved, one way or the other."

Sam felt pity for the poor thing. "Don't you have any other options?" he asked. "Must you risk your life just for . . . ah . . . a night of love?"

"It is so, Earth-Sam. I have no choice. Once the courtship reaches this last plateau there is no turning back. I have assumed the male role and must meet my lover as nature intended. For good or ill, I am committed."

Sam recalled saying much the same thing on the eve of his first marriage, and it proved only slightly less disastrous than this might turn out to be. "Well," he advised somberly, "in matters of the heart there's always a time when the delights of romance overcome your natural aversion to danger. When that happens all you can do is go with the flow and let nature take its path."

"Good advice, friend Earth-Sam. I thank you."

"And I wish you luck, Sslovva," Sam said sympathetically as the Rix went off, dragging his newly-grown equipment with him.

After all of the discussions and despite every remedy Sam could think of, the Mephitisites were unwilling to relinquish the rights to the lands ceded to them by the Scrofulosans' ancestors.

"You accepted our original bid," the Mephitisites argued, "Your people took what we offered. I recall how pleased your people were, at the time. Acted as if *you* had gotten the better edge of the deal."

The Scrofulosan descendants, on the other hand, remained intransigent that the Mephitisites depart the planet.

"Our poor ancestors didn't understand the value of the worthless things that you offered. You took advantage of their naïveté," Offal accused with a sniff.

Sam could sympathize with that. For a while he had thought the cheap translator that Ahbbbb had given him was the most wonderful device in creation, that is until Sslovva set him straight.

Then he realized what the Mephitisite Speaker *du jour* had said. "Wait a minute," he yelled as the machine huffed and wheezed to keep up with his rapid speech. "How could you remember their reaction if it was so many generations ago? How old are you anyway?"

"Why, forty of your years," the sluggish alien replied with an abrupt blast of wind. "I was a first-level trader at that time, you understand—a huge child, not the gracefully edited adult you see before you."

Sam turned to the Scrofulosan delegation. "You told me that this place had been held by you for generations! You said that it was your great-etcetera-grandaunts who laid down the first scent trails to the God Hole. You said that this was your ancestral home. Now it appears that you only settled this place a few years ago!"

Offal responded quickly. "I do not understand why you are so upset. You

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seem to have a firm grasp of the facts."

How could he have a firm grasp of the facts in the face of the absurd statements they had just made? "But, but. . . ," he began, when an idea suddenly occurred to him. "How old are *you?*" he demanded, pointing at Offal.

"Nearly two of your years!" Offal replied proudly in a little puff of pepper, "and still as spry as ever! However, I will retire as soon as this sordid business is straightened out. Then I will be free to spend my final days in peaceful communion with the wondrous effluent of our God."

Sam sat abruptly. He'd assumed that the Scrofulosans had held this place nearly forever. He had thought that the Mephitisites were the intruders. Now, it looked like they had made their agreement when the planet was largely undeveloped and space not a problem. Now it looked as if it were the Scrofulosans who were the greedy ones, wanting the entire planet for themselves. How was he going to find some common ground?

Sam decided to take a few days off and see the sights. Perhaps he could get an idea of how to proceed from the current impasse if he learned more about the planet. Chlorine was all too pleased to show him the wonders of the city: the mildew farms, the lovely fungus caverns, the breathtaking (literally) city library, and the great, awesome, slime pits. But the sticklike alien saved the best of the natural wonders for last.

Sam realized that he should have visited the God Hole when he first arrived. After all, it was the center of the devout Scrofulosans' religion—their holy of holies, in a manner of speaking. The God Hole turned out to be a volcanic fumarole that, regular as clockwork, belched forth a gross mixture of hydrogen, sulfur, nitrogen, and ammonia, interspersed with fragments of whatever strange minerals had been created in this planet's mantle. The Hole was the source of the frequent roaring sounds that cued every Scrofulosan to prostrate themselves. It was their equivalent of Mount Fuji, the Holy See, and Buddha's Tree.

Along with the effluvia thrown from the fumarole were globs of dreadful black goo that smelled pretty rank, but somewhat familiar, although he couldn't place it. Of course, considering the number of rotten smells he'd encountered since arriving, it was no surprise that he should be confused over one or another. The expelled gobs would roll downhill, gathering soil to their sticky surfaces until, by the time they reached the bottom they became appreciable-sized boulders.

Eager Scrofulosans scurried about immediately after each eruption, using baskets on long poles to catch as many of the globs as they could before they hit the ground. Wait a minute; hadn't Chlorine said they were *priests?* Suddenly, a connection clicked and he recalled why the smell was familiar. These globs smelled like the oily residue the Mephitisites collected in their pool. What was even more important was that it was also the aromatic component of that

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hideous gift—these globs must be the stuff to which the priests added the other junk. The gift wasn't just art—it was religious art, Sam realized. And their art was literally a gift from God.

And he knew how to use that gift.

Phluttt-two, the new Speaker for the Mephitisites, had just inhaled to begin the traditional opening complaint when Sam interrupted. "I think the time to come to an agreement is at hand," he declared.

Both sets of the aliens drew back, as Sam violated the protocols that had been established. Offal prepared to join the sputtering Phluttt-two in protest when Sam pulled a bundle out of his kit and placed it on the table.

"One of the first principles of negotiation is to know what you want, and what you are willing to give in return. Now, it has occurred to me that both of you are wanting, but neither is willing to give. Both of you are unwilling to bend because there is something here that you value highly. Isn't that true?" There were reluctant sniffs of grudging agreement from both sides as Sam continued.

"What if I were to show something that was of great value to one of you, something that you would be willing to pay any price to possess? Would you then agree to a settlement?"

"Preposterous," Offal wafted. "These creatures have nothing that would make us abandon our homes, our city, our planet!"

"Ridiculous," belched Phluttt-two. "There is nothing that these creatures could offer that would make us—Where did you get THAT!" All of the Mephitisites gathered around the package that Sam had unwrapped as Phluttt-two was venting.

In the center of the table was a fresh sculpture that Sam had brought from the factory near the God Hole, reeking in all of its odoriferous glory, adding its own peculiar stench to the room. "I would say that a steady supply of these might make leaving the planet to the Scrofulosans mighty tempting, wouldn't it?"

WHOOOOOSH, WHOOOOSH, WHOOOSH!! "Naturally it would depend upon the quantities—oh my, but this is exquisite—and the quality of any—oh lord, this is so GOOD—and the price that might be asked." Phluttt sputtered in a slobbery finish.

"I would say that delivery of a dozen or so of these every week would be a fair price, wouldn't you say?"

"A dozen a *week!* Oh my, uh, could you make that two dozen—and one immediately. As a matter of fact, we'll take this one with us." Some of the Mephitisites were already hustling toward the door with the lump of black glop. "Sorry that we can't stay. We have a rather sudden dinner appointment. Good-bye!" Phluttt exclaimed as it raced to catch up with the crowd.

The Scrofulosans stood stock still, amazed at this sudden turn of events. Offal was nearly knocked scentless at the swift agreement. "Done!" Offal squirted at the Speakers' retreating back and turned to Sam.

"God works in mysterious ways. Who could have expected that such vile creatures shared our religion? Yes,

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deaf-beast from Earth, now that you have revealed their true natures we will provide whatever it takes. It makes me proud to think that the Mephitisites will leave to spread God's message far and wide. Two dozen, no, we will deliver three dozen each week."

"Better give them the two dozen for the rights and demand Glax credits for anything else," Sam advised, pleased at their enthusiasm to work within the agreement he had defined.

"*Sell* our religious artifacts!" Chlorine reeked sulfurously. "That is a violation of—how much do you think we could get?"

"I'd say you'd better charge at least fifty Glax credits apiece, not a Glizzatina less! I'll give you odds that they'll pay, too."

"Fifty?" Offal momentarily lost her control at the prospect of sudden wealth and spurted the scent of violets. Sam realized that the Scrofulosan must have really been overcome to have emitted such a sweet fragrance. "Fifty credits would be enough to buy a small starship, with change left over for a freighter," Offal wafted in shock. "We can afford to settle other planets! We can spread our God to the far reaches of the Galaxy!"

Sam could hardly wait.

Judging from their reactions the next day, both sides obviously felt that they had screwed the other royally—it was the best type of agreement. The surviving and badly tattered Mephitisites, including the new Speaker, who staggered to the meeting the next morning, were overjoyed to verify that they would receive a steady supply of Scrofulosan religious artifacts once they had their population off of the planet.

The Scrofulosans were happy that they would finally have their planet to themselves. The monetary arrangements Sam arranged were nice, too.

Chlorine visited Sam just before he left for the ship that awaited him in orbit overhead. Ahbbbb had booked him on a Dimannian luxury liner. "It has the very finest of accommodations," she'd hummed during their last ansible call. After the last few weeks on Scrofulous Five anything that was dry and lacked distinct aromas would be a welcome change as far as Sam was concerned. Luxurious accommodations would be a bonus that he felt he richly deserved.

The Scrofulosan presented him a small package. "It is a special reward for all you have done for us, deaf-beast. It is our way of showing how much we appreciate your fine job of achieving accord between us and bringing those alien Mephitisites to God." The gift was obviously another of the damned sculptures.

"I shall treasure it always," he said. He hadn't the heart to tell Chlorine the truth about the Mephitisites' use of the objects. As the new Speaker, Phluttt-two so succinctly belched, just before departing eagerly for his final gourmet dinner; Whoosh-phlatt-blah-blah-whoosh, blah-blaat! which had translated as "A superbly delicious condiment—especially when lightly frowlzed!"

Sslovva had not been around for several days and Sam began to fear the

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worst. He had to admit that he had grown to like the little fellow and hated the idea that the tiny Rix could have made a fatal error in the pursuit of love. As he waited to board the ship he occasionally saw one of the Rix hopping along a passageway, but was never close enough to determine whether it was Sslovva or not.

So he was doubly surprised to see the tiny Rix just as he started to squeeze himself through the narrow, diamond-shaped Dimannian airlock. "Where have you been?" Sam asked by way of greeting. "I was getting worried about you. Didn't think I'd see you before I left."

CLICK! "I wouldn't have let you get away without thanking you for your sage advice, Earth-Sam. As a result of my decision I feel wonderful. It was the most moving experience of my life. Oh, I cannot believe how unfulfilled I was before this happened, how limited were my horizons, how—"

"OK, OK, so you got laid and it felt great. How did the little lady, Sslinno, come out?" Sam could only guess what the poor thing had gone through—something appropriate to the nightmares of the New Victorians, he imagined.

"Sslinno? Oh, she is fine, a little tired perhaps, but what can you expect after laying all of those eggs and building that glorious, unbelievably sexy incubator."

"Incubator? Eggs? I thought that you two, er, that is . . ." Sam stumbled for a moment and then decided that the direct approach was best. "How *did* you do it?" he asked, point blank.

The Rix hopped back. "Why Sam, that is a very personal question. However, since you shared your own ridiculous mating practices with me, I will tell you. We only did it the normal way, after all, this was the first time for both of us!"

Oh yeah, Sam thought, remembering the wicked looking thing that Sslovva had grown in preparation for his tryst, and what would the "normal" way be?

Sslovva continued; "After Sslinno confirmed to me that she was in the female phase, she proved it by laying a beautiful clutch of eggs and then building an incubator over them, striving her utmost to make it impenetrable. Oh, Earth-Sam, it was the most wonderful, beautiful assemblage ever created; it had solid ceramic coatings, steel structural supports, and a ferroconcrete core with a titanium cap. As I watched it grow I felt myself become increasingly excited; this was one formidable female, one worthy of my attentions. The lust in me was nearly irresistible.

"Then, after she placed the final cap on the incubator, she did the challenge dance and dared me to assault it. She danced around for hours, defending the nest, moving with agility to block my every feint, working me up to the point that I thought I would explode. Finally, I could stand it no longer and, leaping over her to surmount the nest with a strength that I did not know I possessed, I found the single weak point, drilled into it, and snapped off my positor to seal the breach and fertilize our brood. Sslinno sang the submission song when I

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broke free and I did the victory dance in response. It was the most wonderful, fulfilling experience of my life."

Sam sighed; as on Earth, descriptions of the actual event turned out to be such a disappointment. "So, after a while I guess there will be a couple of little Rix from you two?"

"A couple? No, Earth-Sam, if what I suspect is true about the potency that we both felt, then Scrofulous Five will have a new contingent of Rix engineers within a year—probably a hundred or more. Our group will once again be back to full strength! Thank you Earth-Sam, thank you for your sage advice."

Such were the ways of love among the Galactics, Sam thought as he said his farewells and quickly struggled through the hatch.

He just hoped that he could get inside before Sslovva asked him to be the godfather. ■

In these . . . United States, it has long been axiomatic that any endeavor worth the attention of a publicity flack must be inaugurated by a quota of celebrities who need not necessarily be aware of exactly what they are sponsoring.

—Ernest K. Gann

The right way [to get at truth] is to be open-minded, to state the facts as you see them, and to be willing to acknowledge it frankly if you are shown to be wrong. And above all, to remain good humored.

—Colin Wilson

Too often the contrivances and machines built by early workers in the art, after a brief though strenuous existence, find their way to the junk heap long before their value as historical documents becomes apparent.

—Merrit Crawford

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BRASS TACKS

Dear Editor:

I wish to point out a small error in "Tunneling Through the Lightspeed Barrier" by John G. Cramer in the December 1995 issue. After stating that "A preferred reference frame for the Universe should become apparent," the author refers to "back-in-time communication" as "the other interesting SF implication of FTL communication."

If the author meant the other possible implication, well and good. But FTL communication, or even travel, only requires one of these as a consequence, not both. Yes, even a speed of 1.01c, let alone 4.7c, will look time-reversed from some inertial reference frames.

But, if there is a preferred reference frame, then perhaps all FTL phenomena appear to move forward in time from the viewpoint of that one particular reference frame, allowing FTL travel even if the commonsense view of causality is the ironclad law of nature.

On the other hand, if there is no preferred reference frame, then a velocity that can be generated within one frame can be generated within any frame, and then one is allowed to, in effect, *tack against the winds of time on a voyage to yesteryear.*

The argument that FTL travel implies time travel to the past, originally presented to prove that FTL is impossible in principle, strongly depends on all inertial frames being exactly equivalent, even in terms of whatever unknown forces might power an FTL drive. My own pedestrian inclination recoils from abandoning causality, but I find a preferred reference frame for some phenomena no more threatening than the discovery of a white crow or a black swan.

Incidentally, this means that I would be very interested if Dr. Nimtz attempted an experiment of the Michelson-Morley type with his discovery.

JOHN SAVARD

Edmonton, Alberta
Canada

P.S. The cited references in your article involving Dr. Nimtz were slightly in error—they should be as follows instead of both appearing in *Physical Review Letters,* as claimed:

W. Heitmann, G. Nimtz, *Physics Letters,* vol. A196 (1994), p. 154.

A. Enders, G. Nimtz, *Physical Review E,* v. 48 (1994), p. 632.

Dear Mr. Sheffield:

I noticed your "A Handful of Heresies" in the recent *Analog.* "The Cooling of Cold Fusion" section certainly

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caught my attention. How wrong and misguided you were in your conclusion that the discovery of Drs. Pons and Fleischmann was bogus!

In a modest attempt to prevent you from sticking your foot in your mouth again, I enclose the first three issues of *Infinite Energy*. You may wish to become a subscriber to follow what is going on. This is not science fiction. This is real commercial development and science going on right now, especially in Japan. There no longer can be any doubt that stupendous energies are being released in what were heretofore regarded as chemical systems. Furthermore, even though "cold fusion" is certainly not classical fusion, as has been obvious from the start except to nitwit skeptics with their strawman D-D hot fusion reaction, there is overwhelming proof that a variety of nuclear reactions are occurring in Pd and Ni lattices. What Pons and Fleischmann found was but the tip of an iceberg. Too bad you have missed the excitement of the last six years. There is still a chance, however, to join the new energy revolution!

I am especially troubled that you implied in your article that research was still going on in cold fusion six years after the Utah announcement. (At least you noted that Pons and Fleischmann were still working. Why didn't you mention that they were working for a Toyota affiliate?) This means that you have not paid attention to the now widely published, peer-reviewed articles on the subject that substantiate the phenomena associated with cold fusion. Please, in the future when you write about a topic, at least do proper research so that you know what you are talking about! In this instance, you obviously failed, citing as a supposed authority on the cold fusion saga the highly flawed account of cold fusion—*Too Hot to Handle*. As I like to say about Dr. Frank Close's treatment of the cold fusion story, he wasn't frank and he wasn't even close.

There has just been a major turning point in the cold fusion story that you should know about. The people at a major U.S. cold fusion company, CETI of Dallas, TX, now have running a small cold fusion cell that has already been tested repeatedly on runs that last many days. At a hot fusion gathering two weeks ago in Champaign, IL, its thermal output was around 5 watts with an input of 60 milliwatts. All observers were free to make measurements on the unit and many did. Many of the hot fusioneers were stunned. This demonstration produced thousands of megajoules per mole of palladium (there are only 45 milligrams of Pd in each cell). This is obviously *not* chemistry!!! When was the last time you saw a glass of ordinary water stay hot for a few days?

Oh, about that crack that Sheldon Glashow made that "sticks in [your] mind"—"Never trust a four-letter state." Thanks! Yet another great quote for our collection from the arrogant "it can't be true" nuclear physicists. Look up what another physics Nobelist, Leon Lederman, had to say about cold fusion in *The God Particle*—another instance of foot-in-mouth.

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Here's a bit of information about another state, whose abbreviation at least is four-letters: Mass. The much-touted MIT hot fusion lab's attempt in 1989 to replicate Pons and Fleischmann's experiment actually got excess heat in its heavy water cell, but a grotesque episode of data-massaging (i.e. scientific fraud) prevented the world from knowing about it. I attach a scientific paper by another MIT graduate that proves that that data were unethically manipulated to appear null. I suppose we should say, "Never trust a state whose abbreviation is a physical quantity."

My very best wishes to you in the cold fusion and new energy age! (Whether you believe it will soon come or not.)

EUGENE F. MALLOVE, SC.D.
Concord, NH

The author replies. . . .
Dear Dr. Mallove,

Scientific heresies, as I tried to make clear in my opening remarks in the *Analog* article, don't have to be *wrong*. They merely have to be *contrary to the accepted scientific wisdom of the time*. Cold fusion fits that description perfectly. As is the case of vitamin C, or was originally the case with an asteroid impact as a proposed mechanism to kill off the dinosaurs, "accepted" scientific wisdom makes these things a heresy.

As even a casual reading of my *Analog* article should make clear, I have a lot of sympathy for Pons and Fleischmann. They were pushed by university administrators into circumventing normal scientific publication procedures, and into making a premature announcement of results. They, particularly Fleischmann, are distinguished scientists. They have both suffered, in terms of careers and peer opinion. Their decision to continue their work outside the United States was a painful necessity, not a first choice.

Had they followed a more conventional publication route, the results might have been very different. The obvious parallel here is in the area of high temperature superconductivity. In 1986, Muller and Bednorz produced the first ceramic superconductors. Such things were "impossible" according to conventional theories. But when experiment and theory disagree, theory must change. Muller and Bednorz won the 1987 Nobel Prize for physics.

Were Pons and Fleischmann robbed of similar fame by the actions of others? Possibly. However, martyrdom is not enough to make a theory correct. Nor is enthusiastic championing of the cause. The only thing that counts in this case, as in many others, is replication of results and practical realization. That there are attempts to achieve this realization today is good. I love it when science is surprised, and I would be as pleased as anyone if cold fusion became a standard commercial item.

My knowledge of the field does not, as you suggest, begin and end with Frank Close's book. I know the work of Edmund Storms, and considered citing his 1994 paper on cold fusion that appeared in *Technology Review*. However, as you will see from

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my article, I decided for each "heresy" to provide a single reference, and that a widely-available book rather than an article. I have followed the Italian ENEA work, and I consider Franco Scaramuzzi one of the most able and careful researchers in the field. I have read David Goodstein's balanced 1994 article on "Pariah Science" in *The American Scholar,* which points out how cold fusion research was marred at its birth, by the manner of the announcement by Pons and Fleischmann. I am aware of the "heat threshold" value of 0.85 for the deuterium/palladium atomic ratio, reported by both American and Japanese groups, and cited as of pivotal significance by Scaramuzzi in his December, 1993 presentation in Rome. I regard it as likely that *something* is there, though the explanations of causes offered to date are not persuasive.

However, your opinions and mine are not the issue here. Until *most scientists,* particularly most physicists, change their minds, the idea of cold fusion will lie outside the mainstream of science. I assume you would agree with me, that most scientists have not yet changed their minds. If so, then regardless of any *future* general acceptance, and regardless of wishful thinking, and even regardless of truth, cold fusion remains today a scientific heresy.

CHARLES SHEFFIELD, PH.D.

Dear Stan,

I think Charles Sheffield inadvertently demonstrated the existence of time warps with his December fact article, "A Handful of Heresies," since he's obviously been in one with respect to cold fusion. (Honesty compells me to admit I was in the same time warp myself until about a year ago.)

You see, cold fusion is alive and well, although the name is now recognized by many to be either misleading or overly restrictive (some prefer New Hydrogen Technology, or simply to talk of Over Unity machines). True, the physicists found few neutrons—however, the chemists (and others) still find (with heavy water, light water, palladium and nonpalladium electrodes, cavitation devices, etc.) whopping amounts of excess heat energy, the total joule count far exceeding the input energy. Since Sheffield likes to mention Nobel prize winners, I'd like to point out that this lack of neutrons didn't bother Julian Schwinger, who noted that CF seemed to be largely aneutronic, and went on looking for an explanation (unlike the physics establishment, which went into denial).

There simply is no doubt (if you care to look even a little bit) that CF is real. Since Sheffield is a Brit, I'd like to point out that Arthur C. Clarke has looked and said, "Well, there goes the paradigm." (OK, I said that, but Clarke said words to the same effect.) Although measuring neutron flux is difficult, calorimetry at the multiwatt level is not, and dozens of experiments of all shapes and sizes routinely show anywhere from 100% to 1000% excess energy coming from CF devices, and it's just too damn bad that those finicky neutrons aren't showing up to kill off the heretics. Also worth noting is that many experiments also show incontrovertable evidence of transmu-

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tation, and even the elusive helium of a "normal" fusion reaction has shown up (which was demanded by physicists as proof of the effect up until it was found). And oh yes, all of the possible contamination mechanisms have been, aggressively, ruled out.

I will agree with Sheffield that Sheldon Glashow's concluding dismissive remark: "Never trust a four-letter state," sticks in the mind. Unfortunately, it does so for its stupidity and not its cogency.

JEFFERY D. KOOISTRA

Dear Stan,

I just finished reading "A More Perfect Union," (December 1995), and I found a very serious flaw in it, specifically, the discription of the Constitution amendment process for the virtual reps.

First, an amendment must start in a single location, either congress or a constitutional convention. Second, the amendment must be ratified, not by the people, but by the legislatures of the states. Third, the amendment must be ratified by three-fourths of the states not by two-thirds of the states.

I strongly recommend that all parties concerned, including you Stan, read the constitution article V for a discussion on amending the constitution.

I will leave it to others to talk about the viability of computer programs to represent us.

MICHAEL KILLIAN
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E-mail: 73004.3137@CompuServe.com

The author replies. . . .

Dear Stan,

Mr. Killian is right, of course, and while I could hide behind "my story is in the future and who knows what may have changed," that's a weenie defense, and I won't. He's got me dead to rights, and I have no excuse for such a basic mistake.

I appreciate Mr. Killian taking the trouble to write, and I appreciate the civilized tone of his letter ("flaming" didn't start with the Internet). But at the same time, I'm disappointed. I've now written two stories about politics in the future (the other was "The Fundamental Right" in the May 1992 issue), and the only letter I've ever received is this one, correcting me on details (admittedly, important details).

Personally, I'm fascinated with the concept of democracy: on the one hand it is slimy, corrupt, cynical, almost a parody of itself; on the other, it is the hope and envy of the world. So my stories are designed to provoke thought, comment, outrage, or diatribes on the function of democracy in a free society, the duty of citizens in a free society, the nature of election campaigns and what people respond to.

But in Brass Tacks nothing has been forthcoming. Surely there is someone out there who has opinions on these topics, who is willing to venture beyond stuff anyone can look up. I'm not denigrating Mr. Killian's contribution, because he's right. I just hoped for something more.

DOUG LARSEN

(continued on page 281)

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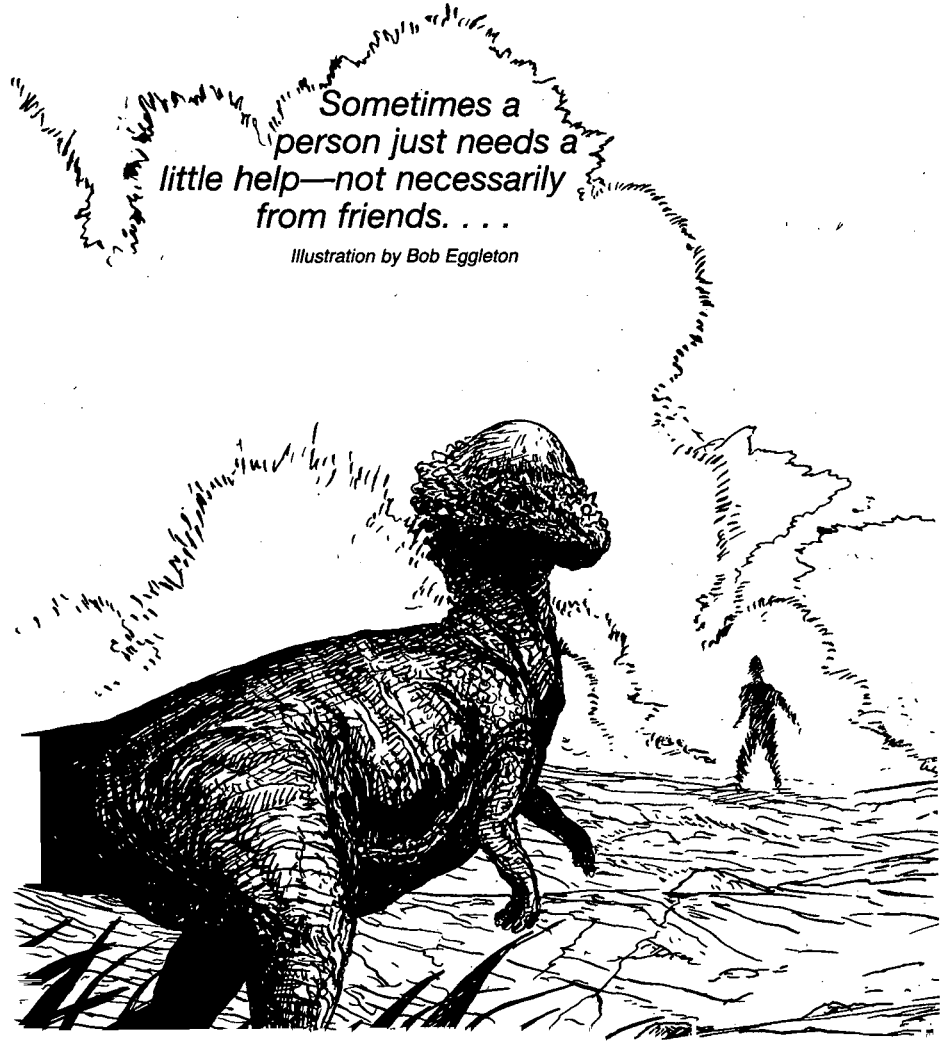
by Pauline Ashwell

BONEHEADS

Sometimes a person just needs a little help—not necessarily from friends. . . .

Illustration by Bob Eggleton



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When boldly going where no man has gone before, which—since *Homo sapiens* would not evolve for 90,000,000 years and the first member of the expedition had arrived on Indication One only three months ago—described most places in the northern half of the island, and particularly when this involves dense forest, common sense suggests marking the route.

Standing at the junction of two trails (one of which he must have traversed quite recently, without noticing the other) Jonathan Craile (M.D., F.W.C.P) acknowledged ruefully that common sense seemed to have deserted him.

The trails had been made, presumably, by rhynchosaurs—snouty, pig-sized reptiles, the commonest large animals on the island. Their comings and goings had beaten the reddish earth as hard as cement.

The hunters who had sometimes acted as Craile's guides in the wilder parts of the world—some still existed, even in 2089—might have been able to see traces of his moccasins. He could not.

Despite the tropical sunlight it was dark in the forest, which mostly consisted of conifers, with stands of palm-like "cycads" and the occasional tree-fern. The air was warm, still, and silent. Monkeys had yet to evolve, and such birds as were around squawked, when they felt like it, but did not sing.

Craile felt very much alone.

Well, he *was* alone. Very much so. The total human population of the Earth at this point of time—somewhere around the middle of the Cretaceous—numbered twenty-nine. Twenty-eight of them were either at base, halfway up Observatory Hill, or working near Lake Possible at the southern end of the island. The total area of Indication One was roughly thirteen miles by eight; this northern section took up at least half of the map, so its population density came to about one person per fifty square miles. Craile was the one.

You couldn't get much more alone than that.

Furthermore, nobody knew where he was. Those members of the expedition currently at base believed him to have gone to Lake Possible, while those at the lake supposed, if they happened to think of him, that he was still at base. Several people who had been at the lake for a couple of weeks were due to return, and Craile had planned to wander in behind them. Nobody was likely to wonder why he should walk seven miles in the morning in order to walk seven miles back a few hours later. It was not as though he had anything more important to do.

The easiest route to and from the lake lay along the seashore. Journeys had to take account of the tides, which meant that, barring accidents, the returning group would reach the base by midafternoon. Craile estimated that it had taken him about four hours to get where he was, but he should be able to retrace his steps in considerably less. Even so, if he wanted to get back unnoticed it was high time to start.

Not that there was any actual rule

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against going off alone, without stating one's intentions. Or if there was, no one had thought to mention it to him.

When Craile was hurriedly Displaced a couple of months after the rest of the expedition, he was told that he would be briefed when he arrived. This had meant, in practice, that he got to hear whatever happened to be on his informant's mind at the time.

Several times the explanation had been inspired by some minor catastrophe, or the threat of one—as when Craile, seeing a number of large fronds spread out in a patch of shade, had wandered across to sit down. He learned, not a moment too soon, that they covered a pit full of poisonous slime. There were about twenty pits scattered around, each one filled with a careful selection of vegetation and then inoculated with one or more strains of bacteria, in order to produce a variety of chemicals; many of them actively poisonous, and none of them good for the health.

Pits and their contents belonged to the six members of the Plastics team. For the next week or so there was always one of them around whenever Craile was out of his hut. Hovering.

What annoyed him most was that they appeared to be genuinely worried, not that he might upset the production of monomers that they needed for their work, but that he might break one of his poor old legs. Or get a nasty rash on his poor old skin.

All right, he was fifty-three; more than twice the age of anyone else in the world at this moment (except for the chief engineer and general manager, Yaro Land, who was nearing forty). That didn't mean he was incapable of looking after himself. Or, if given proper information, of avoiding hidden menaces or other items best left alone. . . .

Such as the cushion-like balloons clustered here and there on the plateau around base camp. Naturally, they had caught his eye on his very first morning, because while they were made of transparent plastic, the lower half was coated with silver foil, giving the impression that the flora of Indication One ran to metallic buttercups two feet across.

He had gone to the nearest cluster and had begun to investigate the arrangement of whitish rods which surrounded each balloon, when an agitated young woman hauled him away. The inner surface of the balloons, he learned, was plated with solar cells, which were recharging batteries from the hand-lasers used for cutting and shaping wood. The rods were there to keep the balloons facing directly into the Sun. Not only had Craile upset the arrangement by poking about, he had ignored repeated yells of "Shadow!" and gone on cutting off sunlight from at least three.

Craile had been prepared for the peculiarities of life in the Cretaceous, as such, but not for those that were due to the Time Displacement process itself. Nobody in 2089 had bothered to warn him about its limitations. Winton Boatrace, who had invented it, was willing to maunder on indefinitely about how it worked—though he evidently didn't expect to be under-

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stood—but had not thought to mention the point of real practical importance, which was that his blasted apparatus would only Displace just so much mass—somewhere between four and five tonnes. Then it stopped.

Live bodies, a miniaturized computer, a single rocket-gun, food for the first comers until they were organized to find their own . . . everything Displaced contributed to a phenomenon referred to as *temporal strain* in the essential guts of the machinery, and when that reached a certain level the thing did not work any longer. As simple as that.

Once understood, this accounted for a lot. For one thing it explained why he had been chosen as medical officer. Nothing to do with thirty years spent doctoring in places where modern technology had not yet arrived—or was in retreat. There were doctors in their thirties whose experience of bush life was perfectly adequate; but they tended to be 180-lb stalwarts. The very weediest topped 140 lbs, whereas Craile, whose growth had stopped when he was five foot one, had never weighed more than 90 lbs, even after the most self-indulgent leave.

Time Displacement was expensive in power; about Cr 5,000 per lb of mass Displaced. At first Craile thought that was why he had been selected.

It did occur to him, on the first day, that to put highly-trained scientists and craftsmen to dig holes with bone shovels, or weave basket-work traps to catch fish and lobsters for the camp's dinner, was the falsest kind of economy. Even so it was several days before he grasped that more was involved than penny-pinching. Tools on Indication One were made of stone and bone and wood, because there was no mass-capacity available to Displace metal ones; and specialists of all kinds took turns hunting and gathering local foods, because the alternative was to go hungry.

The colonists on Indication One would have been more than human, Craile thought, if they had not wondered why 88 lbs of mass capacity had been used to Displace *him*, when there was so much else they could have used. They were young and healthy. If there were any local diseases they could catch, which was unlikely, they had a plentiful supply of Unimycin in self-refrigerating capsules. They had all been trained in the handling of injuries; not just first aid, but nursing, physiotherapy, the lot. They had a thermometer and a stethoscope and knew how to use them, and they had put together a useful kit from local materials, including a steam sterilizer (pottery), a supply of clean absorbent moss, wooden splints, and strips of leather with which to tie them in place. He knew a great many procedures that they didn't, of course, but few if any were safe outside a modern hospital. So what use would he be?

In the last few weeks Craile had wondered that more and more frequently.

As explained to him by Dr. Boatrace, he had two functions: firstly, to deal with any illness or accident that required more than first aid, so that

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nobody else need leave their own work for the purpose; and secondly, to act as a spare pair of hands as and when required.

The final objective of the colony on Indication One was to obtain a supply of the rarer metals; not by digging for them—so far as was yet known, the island contained no ores at all—but by extracting them from sea water. A series of tunnel sections were to be constructed, lined with a variety of silico-organatoid mixtures, each tailored to accumulate a different metal. The tunnels were to be sunk in the channel between Indication One and the mainland.

That done, the whole colony would be re-Displaced 5,000 years ahead, to a period when the bed of the channel would have been raised above sea-level. There they would shovel the metal-containing sludge into one of the many caves along the shore. In 2089 that tract of land belonged to Cretaceous Minerals, Inc., who would set to work ninety million years later to dig the stuff up.

The whole scheme struck Craile as a farcical gamble, with about one chance in a thousand of succeeding. However there was no doubt that everyone else on Indication One took it very seriously indeed.

They had ten years in which to bring it off. Every time one of the potters (who in the absence of metals were expected to make much of the equipment), the engineers, or the plastics team (whose job was to produce the silico-organatoids) had to put his/her specialized work on hold because somebody else was calling for unskilled but absolutely necessary assistance, the whole enterprise suffered.

Craile was perfectly willing to hump loads, support partly completed structures, pass tools, and help in any way that he could. The trouble was, after his early mistakes (plus one or two incidents that were none of his doing but unfortunately occurred when he was close by—as when the spout diverting a small waterfall into the pool where dishes and cooking pots were put to get clean, just happened to collapse a minute or two after he had been inspecting its supports) everyone else on Indication One practically had hysterics if he came anywhere near their constructions.

Maybe they were right. Maybe he *was* some kind of a Jonah. Take this stupid expedition, undertaken with some confused idea of showing that he *could* be useful, given a chance.

Food problems on Indication One were the reverse of those Craile was accustomed to. Protein was abundant; there were quantities of fish in the streams as well as in the sea, a wide variety of shellfish, and the eggs of several marine reptiles which came ashore to lay. One of the pines produced large nuts which, cautiously tested, had proved edible. The young shoots of two species of fern and of a broader-leafed relative of the ginkgo had featured in early meals, after careful testing; but seeds of several fast-growing vegetables had been brought along and these, to general relief, now replaced the local greens as suppliers

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of fiber and vitamin C.

The nutrient in short supply was starch. Until recently it had been obtained from a nameless but abundant plant which grew on the banks of the many streams. This had bulbous stems a couple of inches thick, from which starch could be extracted by a simple but laborious series of operations; drying, grinding, washing out, and drying again. Flapjacks and crackers made from it would have won no prizes in a baking competition, but they were edible and sustaining and one got used to the taste.

Then more or less overnight all the stems shot up to a height of four feet and sprouted large conical heads of stone-hard seeds. In a few days these were stripped bare—by what creatures nobody knew, but small primitive nocturnal mammals were the favorite guess. The remaining stems were about as edible as bamboo.

Supplies of starch were on the point of giving out.

It occurred to Craile that a week or so earlier, while trailing after the Plastics team—they had admitted that he could hardly do any damage by carrying bundles of vegetation for them, provided they chose it themselves—he had noticed a kind of fern with creeping stems, some of them swollen to about the size of a small potato. Wasn't there a species of fern somewhere—New Zealand?—which produced starchy rhizomes that the locals ate?

Unfortunately he did not remember just where he had seen the plant. Somewhere to the north of the camp, and close to a trail; but there were trails all over the place, and he had had no reason at the time to make a note of the landmarks.

However, Craile was fairly sure he could recreate the course of his wanderings; and if he turned out to be wrong there would be no harm done. Not wanting to add to the list of his mistakes, he decided not to mention it to anyone unless and until he had something edible to show. The terrain was rough, but hell, he was experienced enough in bush walking to look where he put his feet. Anyway, if he announced his intentions somebody would feel bound to drop whatever they were supposed to be doing and come along to take care of him.

At first it seemed everything was going well. He found a small clump of ferns with creeping stems that had four swollen lumps on them—not much bigger than his thumb, but it was a start.

After that, nothing. He walked along a number of trails which looked pretty much like the one he remembered, but the big clump he was looking for failed to appear. Repeatedly he saw what seemed to be the right kind of leaves, and plunged off the trail to examine the plants, but none of them showed the kind of growth he was looking for.

Doggedly Craile pursued one meandering path after another; he was now well away from the area he had visited with the Plastics group, but the blasted plants must grow in other places as well. Probably the one he had found was an outlier, and the main habitat of the species

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was farther away. . . .

Finally, and with reluctance, he had decided to turn back. Then at the very first fork in the trail he did not know which way to go.

Base lay south, he was sure of that. He looked up. The Sun was directly overhead.

Observatory Hill was the highest point on the island. Slowly and deliberately, Craile turned completely around. The view in every direction was blocked by trees. Where he stood, the ground was flat; but fifty yards away in either direction it sloped gently upwards. He couldn't see which ridge was the higher—both summits disappeared among the trees.

Unbelievably, after all his experience, he had gotten himself lost.

Of course, for the last twenty years his experience had been mostly of being put down by helicopter as close as possible to his destination, and then conducted by a guide for the rest of the way. He had got out of the habit of noting landmarks and marking his trail. It had not occurred to him to use any part of his minute baggage allowance to bring a compass along. . . . Wasn't there something about the moss growing on the south side? He looked quickly at the nearest tree. No moss. Plenty of lichens, all the way around.

It was high time to start using some of his alleged bush-craft, not to mention his common sense. Like recognizing that what he needed at the moment was a rest.

He sat down with his back to a tree, leaned his head against the trunk, and carefully noted the pattern of branches that marked the position of the Sun. Then he took from his pouch the lunch Elsa had given him—four radishes, a couple of crackers, and a smoked fish.

Too late, he realized that he should have kept the radishes till last, to clear his palate of the lingering taste of the fish. He did have a water bottle, hollowed from a sapling stem—gourds had been planted, but were less than half grown—but it held only a few mouthfuls. He had drunk several times from streams crossed during his wanderings. Better keep what he had, for now, not knowing when he would next come to water that was fit to drink.

The Sun had crawled just perceptibly down the sky. It appeared that the opposite side of the valley lay more or less west. Which meant if he turned left along the valley bottom he would be going more or less south. He heaved himself to his feet and set off.

This time he faithfully followed the teaching of the Boy Scout Handbook, lining up his route from one tree to another, scratching arrows on the ground at every branch of the trail, and remembering to check his position by the Sun. The need to keep going in a straight line took him through patches of scratchy horsetails and thickets of some whiplike plant that lashed back at him when pushed aside, and finally into a messy and sour-smelling swamp . . . from which he emerged after most of an hour onto a slope of bare rock backed by a basalt cliff, above which loomed the

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distant outline of Observatory Hill.

It was a relief. Of course it was. On the other hand he was bloody tired and it was now mid-afternoon. It would take him two hours at least to get back to base, and the party from Lake Possible might well be there already, now. Whatever he did now, some interfering youngster was going to realize that he had deliberately tricked them and gone exploring by himself, which would make him the big winner at How Dumb Can You Get . . . unless he had something to show for it.

There were a good many fallen branches around, and towards the top of the slope they were dry. Craile assembled materials for a fire, built a small pyramid of twigs and crumbled bark, and focused the sunlight on it with his burning-glass (official issue—matches were reserved for emergencies on Indication One). He got a glow after a minute or so, fanned it to a flame, and fed it carefully.

It took much longer than he expected for the fire to burn down. When, finally, he had a good—fairly good—bed of red coals, he spread his four pathetic little lumps on the hot rock, raked ash over them with a stick, and piled the red coals on top.

Then, for lack of anything to do otherwise, he continued to crouch beside the fire. Presently a drop of sweat fell from his nose, and sizzled. Craile moved away a few feet and for the first time began to notice the clearing as something other than a good place to light a fire.

The area of rock was about the size of a soccer field and variegated by damp hummocks of moss, plus the occasional clump of horsetails growing out of a crack. The upper end was cut off sharply by the cliff, which was about twenty feet high. Elsewhere the rock was bordered by forest. This was much the same here as elsewhere, except that the trees appeared to be in poor condition. There were a good many fallen trunks and stumps with splintered tops, as though the quite moderate winds of Indication One had been too much for them.

Altogether, the place made a rather dismal impression; though that could be because he was strongly conscious that the swamp through which he had waded to get here lurked at the lower end of the slope.

The fire was a heap of gray ash, with charcoal poking through in places. Craile wondered how long it took to cook roots this way. Come to that, he didn't know how long they had been baking; he had forgotten to note the position of the Sun when the process began.

He had started his fire feeling that as he could not get back early enough to avoid notice, but on the other hand nobody would actually be waiting for his return, time hardly mattered. However, he had only a vague idea of how long it would take to reach base. The amount of fuss would be doubled or trebled if he got back after dark. Not to mention the possibility of falling off, into or down some part of the landscape. . . .

He raked one of the roots out of the fire and knocked the ash off it. Small

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enough to begin with, it had shrunk almost to nothing. He got out his knife—his most important possession, kept tethered to his belt by a leather thong—and prodded the thing. The tip of the smaller blade went into it easily enough.

Craile cut the root in half.

Color and texture were the same all the way through. Did that mean it was cooked? He cut off a piece, peeled away the remaining skin and blew on it till it felt cool enough to put in his mouth.

There were other dangers. By the middle of the Cretaceous, land plants had been eaten by land animals for about a hundred and fifty million years; quite enough time for the plants to evolve a few chemical protections. Cyanide, for instance. The lethal stuff had to be locked into some relatively harmless molecule, to stop it killing the parent cell, and most of it stayed that way until mixed with stomach acid; but the cooking process usually released enough to warn off anyone with a sense of smell. He sniffed heartily. No odor of bitter almonds here.

The other chief group of plant poisons, the toxic alkaloids, all tasted bitter. Craile believed—hoped—that quantities too small to register on the taste buds were also too small to be harmful. He licked the bit of root. No bitterness; in fact no taste at all. He put it cautiously into his mouth

Chewed, it took on faint overtones of the fermented gruel fed to children in parts of Africa. Europeans tended to compare the flavor to that of wallpaper paste, though when and why they had tasted that was never explained.

He went on chewing. He would have to swallow the stuff some time, if this experiment was to be of any use, but there was no hurry about it.

What the hell—? His tongue, and the roof of his mouth were stinging furiously. It felt as though the mush he was chewing contained one of the stronger acids—but there was no sour taste.

Craile spat, vigorously; uncorked his water-bottle, washed his mouth, and spat again, repeating the process until he had drained the bottle. His tongue and palate continued to sting. Hurriedly he examined himself for other in effects; but he was not nauseated, or dizzy, his extremities were not numb, his vision was OK. . . .

A memory surfaced, of having gone through this process before, thirty or forty years ago . . . and, yes, because of similar symptoms. The curator of a botanical garden somewhere—Singapore? Rio? Papua?—had given him a fruit like an outsize pinecone with green scales. One end was ripe and tasted like pineapple; the other. . . . Visible differences should have warned him, but he went ahead and cut off a slice. After a couple of mouthfuls his mouth had felt as though he had been eating stinging nettles, raw.

The curator had explained, holding back laughter, that until it ripened the fruit was full of tiny needle-shaped crystals which penetrated the soft tissues of the mouth. In a couple of days they would dissolve; meanwhile there was nothing to be done. Except re-

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member that only those segments of a *ceriman* that had separated from one another were good to eat.

And, dammit, he had been told often enough in New Guinea that taro roots must be cooked for a long time or they made the mouth sore. The cause was the same, according to the books; minute crystals of calcium oxalate. He had forgotten to check for that form of vegetable self-defense.

Craile raked the rest of the roots out of the fire. He was tempted to throw the shriveled little objects away and forget the whole thing. Instead, he wandered over to the nearest patch of forest until he found leaves large enough to wrap them in, then stowed them in his pouch.

He decided that before starting on the journey back he might as well relieve himself. He had stepped behind a tree before it occurred to him that right now, modesty was beside the point. He went ahead anyway, and was just lacing up his leather shorts when a curious rhythmic slapping began, somewhere beyond the far side of the tree.

About to step out of concealment, Cradle thought better of it and peered cautiously round the trunk instead.

Standing with its back to him, three or four yards away, was a dinosaur. It was bipedal and kept shifting from one hind leg to the other, stamping hard on the rock each time.

A troop of small bipedal dinosaurs roamed the plains around Lake Possible. They were herbivorous, and so timid Craile had never got close enough for a detailed view. This was not of the same species. For one thing they stood four feet high at the utmost stretch; whereas this one was leaning forward and even so its head was at least a foot higher than Craile's. They were lean and birdlike; this one was stoutly built and looked three or four times as heavy. It had a thick triangular tail that slapped the rock in time with the stamping.

It was an article of faith among the colonists that no carnosaurs lived on Indication One. The island was simply not big enough to support a breeding population. If any had been caught there when the Tironian Sea surged into its present channel, they would have died out.

Ten minutes ago, he would have thought that a convincing argument.

Craile had looked at pictures of dinosaurs when he was seven years old, like most children, but they had mostly been of the large, dramatic kinds; *Apatosaurus, Tyrannosaurus, Triceratops* and other giants. Obviously there must have been smaller species, but he had no idea how to tell which kinds were liable to eat you; especially when viewing them from the rear. He shrank back behind the tree and did his best to breathe softly.

The stamping was abruptly supplemented by a kind of hissing scream. Very cautiously Craile edged one eye out from behind the tree trunk and saw that the clearing had been invaded by a second dinosaur.

This one was approaching from the far side, and Craile saw it head-on. It was bending forward from the hips, backbone and tail almost horizontal,

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the shorter forelimbs dangling not far above the ground.

His first impression was of warts; dozens of huge, pointed ones, all over the snout. Double rows of flatter knobs arched eyebrow-like over each eye, and above them the head sloped upwards to a great bony dome with a fringe of the pointed warts around its base. The small pig-like eyes looked out sideways and gave the impression almost of being shy, among all these excrescences.

The new arrival took perhaps ten slow paces forward into the clearing and came to a halt, turning its head so that one eye was fixed on the first one.

That individual repeated its hissing scream and bent forwards slowly until its trunk also was almost parallel with the ground. It continued to stamp; but now each time it lowered the raised foot it was planted a few inches farther up the slope. Presently it had edged out of Craile's line of sight. He moved cautiously to the other side of the tree trunk, only to find his view blocked by one of the whippy bushes. Slipping back to his former vantage point he saw that the second creature had straightened up and swiveled round to keep the first in view. A minute later it scuttled up the slope until it was once again on a level with the first; which was once more standing tall.

There followed a kind of slow-motion dance. The object seemed to be to occupy the higher ground, without letting this become obvious. It was also necessary, apparently, to keep a certain distance—the minimum seemed to be thirty yards—between the participants. Maneuvering was complicated by the unevenness of the ground, which near the cliff was split into a jumble of blocks, and by the tendency when in motion to lose sight of the opponent. The latter was thus able to sneak a few steps closer, so that when the other, having arrived at a position higher up the slope, turned, it found itself off-side and had to withdraw.

This, at least, was Craile's interpretation. It was not until the fascination began to wear off that he noticed the third dinosaur. It was lying quietly on its belly at the lower edge of the clearing and its green and brown mottling blended well with the clump of whip-like bushes immediately behind. The crown of its head was less domed than that of the other two. He concluded that it was probably a female and the peculiar contest in the clearing was designed to win its favor, though he couldn't see how.

At that point one of the males—they had shuffled positions so often that he was not sure which—uttered a brief but loud croak and once again lowered its trunk until it was almost parallel with the ground; the domed top of its head directed towards its adversary.

Boneheads. The name floated into Craile's mind, from what source he did not remember. Smallish—for dinosaurs—bipedal herbivores whose skulls were thickened on top by up to ten inches of said bone. The only explanation that paleontologists had come up with—

The second male also screamed and

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lowered itself into the battering-ram position; and on a count of three, they charged.

The sound as their heads collided was not particularly loud, but remarkably suggestive; a one-note tone poem to the mindless cruelties of the sexual arms race. Craile's hands moved involuntarily to his temples.

The two boneheads rebounded from one another; then drew back, step by step, until they once again had room to get up speed. After which, without further ceremony, they charged again.

The paleontologists had got it right. The weird battle crisscrossed the clearing. The high ground—and thus the advantage in momentum—was more or less regularly swapped. The female lay still and made no sound, but her head pointed sometimes in one direction and sometimes in another; Craile had the impression that she was keeping a pretty sharp eye on successive impacts.

After a while the combatants seemed to have given up bothering about the slope and were charging one another more or less on the same level. Then in mid-career the one with its back to Craile stamped one foot onto the remains of the fire. Evidently the insulation of ash above and rock below had kept in a good deal of heat. The bonehead gave vent to a screech unlike any sound it had made before, and leaped sideways. The other came on at full speed, evidently unable to pull up, and Craile realized with sudden horror that it was headed straight for his tree.

He backed away at top speed. Around the fifth or sixth step his foot came down on air instead of rock. After a brief, windmilling imbalance he found himself flat on his back in half an inch of water, over an unknown depth of mud. Before he had really taken this in, there came a thud, followed by creaking; the top of the cycad swayed into his line of vision, fronds swishing gently upwards, and came down on top of him.

The trunk fell to one side, but the mass of stiffened fronds pressed him down into the mud and inspired Craile with the urge to get out from under at any cost. He grappled and thrashed his way through them and got his head above the foliage, and a grip on the end of the tree trunk—only to find himself face to face with the dinosaur.

It was lying belly down along the cycad's trunk. What actually met Craile's eyes was the snout with its crowd of spiky knobs. Whether the sideways-facing eyes saw him he was not sure. They appeared to be open, but the creature did not react to his popping up in what might, or might not, be its field of view. Perhaps it was stunned. He had no idea whether the brains of reptiles were susceptible to that.

Whatever the reason for its quiescence, he felt that it would be safer to keep still. His knees appeared to have gone through the layer of mud and to be resting on rock; his first panicky idea that he might be pushed down and drowned in the stuff had evidently been overdramatic. He stayed where he was.

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After about five minutes—having nothing else to do, Craile had been counting seconds—the bonehead suddenly pushed itself up from the tree trunk (causing Craile's end of it to sink under him) and floundered to its feet. It turned ponderously, hissed, and waddled out of sight.

Craile hauled himself up on to the tree trunk, and froze. The gap where the cycad had stood framed something never seen before by man.

The bonehead that had stepped in the fire appeared to have won by default, and had evidently claimed the prize; or, considering their relative positions at the end of the battle, been claimed. Male and female formed a group balanced on five supports; two thick triangular tails, curled around one another; and three legs. The fourth—the pair were so twined together that Craile could not be sure to which of them it belonged—was bent sharply at the knee, raising the foot so that it rested on the partner's hip.

They were remarkably still. Occasionally one uttered something like a muffled belch, which the other immediately echoed. Once, the whole group suddenly rotated around the entwined tails, and then was still again. Craile was beginning to wonder whether they planned to make a night of it when the one with the raised foot suddenly disengaged it, staggered a couple of steps away, and collapsed on all fours. The other immediately started up the slope at a rapid waddle, whereat the fallen one got its feet under it, rose, and set off even faster in pursuit.

Craile sighed deeply. Relief was tempered by frustration—he had lost any chance of getting back to base before dark

He began crawling carefully along the fallen cycad. About two-thirds of the way along he reached the point where it rested on the edge of the low, rocky platform from which he had fallen. A couple of yards farther on it tilted under his weight and he fell forward over the section of trunk where the bonehead had struck. The bark, and a layer of wood beneath it, had burst open, leaving a splinter-edged depression. Putting a hand into it while pushing himself up, Craile found himself groping in slimy pulp. He swore wearily, wiped his hand on a relatively mud-free part of his tunic, and rolled off the trunk.

The cycad seesawed back to its former portion. Craile sidled cautiously between the ball of torn-up roots and the whiplike branches of a bush beside them; took a look around without seeing any lurking dinosaurs, and emerged into the clearing.

He found with annoyance that his legs shook. He was thirsty, his back and shins were coated with mud, and to reach base he had to walk four or five miles uphill. When he got there he would be faced with a barrage of questions and the answers would display him as a fool.

Maybe he could use his encounter with the boneheads as a distraction?

Ten to one they would think he was making it up. No. Tell them to mind their own business, why not? If he chose to come back after nightfall with mud all over his clothes, what had that got to do with anyone else?

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With the wet legs of his trousers flapping against his shins he set out on the long walk home.

Fortunately the rhynchosaurs—or possibly the boneheads themselves—apparently did a good deal of trekking between the boneheads' fighting-ground and Observation Hill. There was a well-beaten track, which presently joined another that Craile thought he recognized. After a mile or so this was confirmed; he came to a waterfall which he had definitely seen before. He knelt and drank, refilled his water bottle, and was about to step under the fall when he realized that the mud on his clothes had begun to dry up and flake away. He took them off, therefore, before immersing himself thankfully in the pool at the base of the fall.

Clean, and partly revived, he picked off as much mud as he could from his trousers, climbed into them, and began on his tunic.

The back was one huge splotch of mud, flaking a little round the edges, but mostly still wet. He rubbed it over a patch of horsetails and got a fair amount of it off. The front. . . .

What the hell was that whitish goo? He rubbed a little of it between his fingers. It was thick and sticky, like starch paste.

Starch!

He had a sudden flash of memory; New Guinea; a demonstration laid on for tourists, of how to make flour from sago palms in the traditional way. Hadn't there been something in the pamphlet they were handing out about the other species of trees which could be used in a similar way? And weren't some of those trees cycads? He seemed to remember that they had been mostly a last resort, when food ran short; but so what? Food—starchy food—was short here and now.

Was the stuff really starch? He didn't see what else it could be. Better Displace a sample back to 2089 for lab testing, but—

Oh, hell. The fallen trunk was at least a mile back along the way he had come.

Of all the things Craile did not want to do, wasting the effort that had got him this far, and adding the same again, doubled, to the four miles of trudging that already lay between him and base—and supper and bed—was, at this moment, top.

In forty minutes or less the daylight would be gone.

Why not go back for a sample tomorrow? Come to that, there were probably specimens of that type of cycad much closer to base. . . .

Unfortunately all cycads looked pretty much the same to him. Some had enormous cones which spilled pollen all over the place, and some didn't; but he had an idea that that was a matter of gender, or possibly of maturity; not species. No, he would have to go back to the boneheads' arena and find the one that had been knocked down, but tomorrow would do.

Wouldn't it. . . ?

With something like a groan, Craile turned and started back along the way he had come.

He had marked it clearly enough

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and was making good time when a sudden and prolonged thrashing began in the undergrowth to one side. What with, on the one hand, the possibility that he had found a source of starch, and on the other his fatigue, he had more or less forgotten that this was bonehead country. . . . The noise stopped. He could see no disturbance among the branches, probably he had just heard a large rhynchosaur settling down for the might. Not that it was a good idea to fall over one of those in the dark; they could give you a nasty bite. In fact—

No. He was not going to give up, trudge home and come back tomorrow. To hell with common sense.

He went on, treading carefully; even so he arrived at the clearing sooner than he expected. Craile was aware of a creeping sensation around his backbone as he crossed the naked rock; but no boneheads appeared. He found the fallen cycad and dug into the splintery mess where the bonehead had struck. The goo turned out to be the result of the impact; in the less damaged area nearby the center of the trunk was filled with a much firmer pith, about the consistency of raw potato. He dug out a section with his knife, weeded out a few splinters, and bit a piece off.

It was tasteless, but not too bad. He chewed it cautiously. Yes, surely, starch. He moved the bolus to the back of his mouth. . . .

Was there, or was there not a faint bitterness there? He took a cautious sip from his water-bottle and chewed some more. . . . Definitely bitter. Probably an alkaloid of some sort. He spat it out hurriedly, rinsed his mouth, and spat again.

Hell and damnation. He sat down heavily on the trunk, which sank a little under his weight. The stuff was useless, after all. Beaten by the evolutionary arms-race. Cycads 1, Craile 0 . . . . All that effort wasted. He had a strong impulse to sit where he was and try taking root himself.

Something crept into his line of sight. A shadow. The Sun was preparing to go down.

Reluctantly Craile started to rise, or tried to. His legs seemed to have seized up, and the tree-trunk to have gotten lower. After a couple of tries he managed to rock forward on to his feet, whereupon the ball, bristling with roots, rose and got him under the chin. He staggered backwards and sat down again.

Wiping mud from his neck with a handy frond, Craile began to feel that nature was out to get him. A broken root had poked him in the larynx; just a bit longer and sharper and he could be dead. He swallowed painfully, and became aware of renewed bitterness in his mouth. Bits of pith must have lodged in his cheek or somewhere and the alkaloid was still dissolving in his saliva. . . .

This time there was no sudden revelation; just a series of facts that took a couple of minutes to assemble themselves.

Alkaloids were soluble in water; some more so, some less, but all to some extent.

A number of foodstuffs were naturally toxic—cassava, for instance, especially the high-yielding strains—but

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were rendered safely edible by soaking in water.

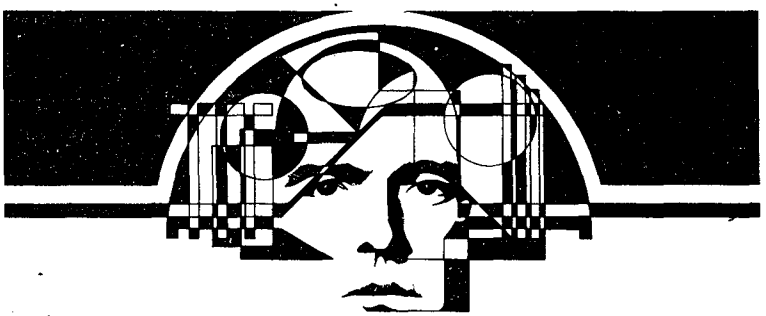
To make sago, the starch had to be washed out of the pith.

Craile took a deep breath; let it out. He got out his knife again, excavated about half a pound of cycad pith and wrapped it in the leaf that had held the fern roots. Wash out the starch of this sample; Displace some for laboratory testing; if necessary wash the remainder again and retest. Or the lab could Displace a do-it-yourself test kit. That would be better. Test every batch on the spot and make sure it was safe to eat. . . .

Damn it, if the people of remote tropical villages could learn to eat cycad starch and survive, so could those on Indication One.

He put the leaf-wrapped parcel in his pouch. Once again, but with entirely different feelings, he started on the journey home. ■

Editor's Note: This story has the same background as "Wings of a Bat," published in Analog *in May 1966.*



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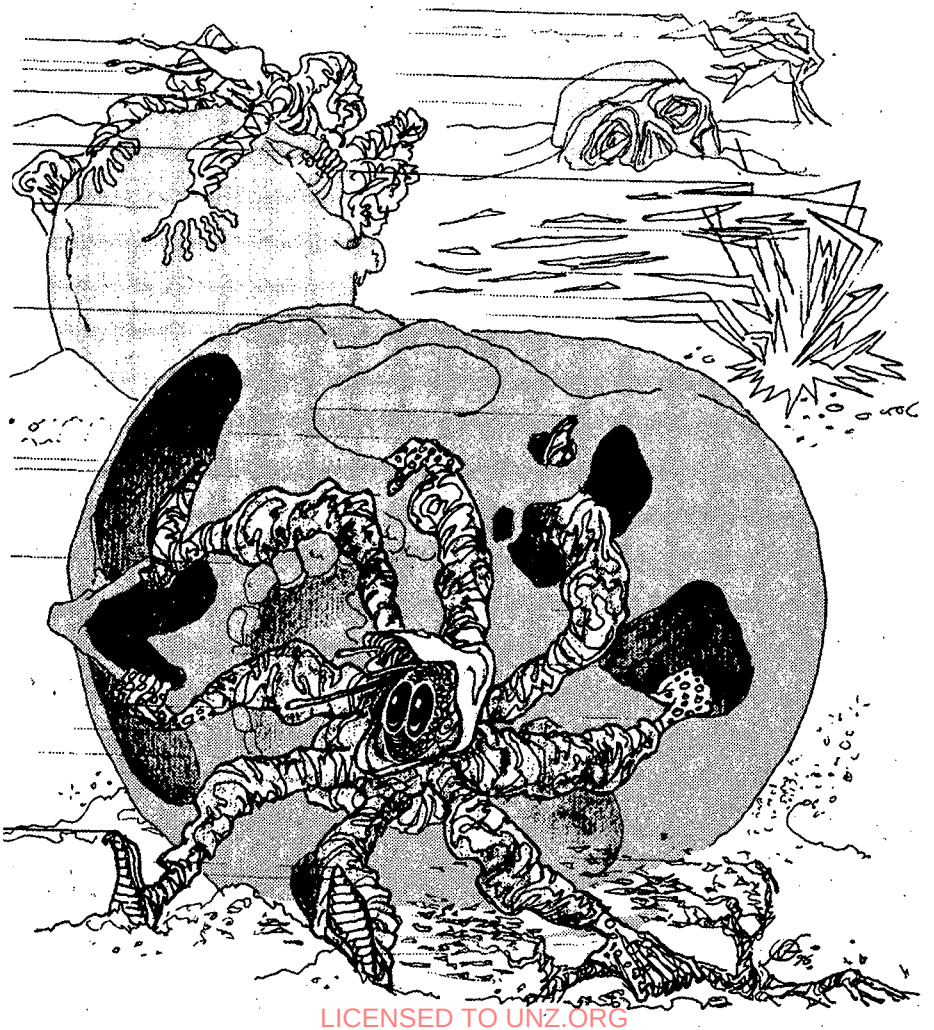
Don D'Ammassa

THORACIC PARK

Any resemblance to anything else you've ever read is, of course, purely coincidental. . . .

Illustration by Kelly Freas



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Chirr was polishing a freshly uncovered human skull when the ornithopter landed just outside the encampment, causing great consternation among the broodlings who were methodically clearing away soil from their latest find. Kachinka, his mate, clashed her mandibles angrily and made an obscene gesture with her antennae.

"Attend to the site," Chirr instructed. "I will deal with this."

He sank into haste posture and used all six legs to cover the intervening space, but even so the newcomer had already disembarked. "Professor Chirr? It's a pleasure to meet you, sir."

"What is the meaning of this intrusion?" Chirr rose to his full height and assumed the posture of outrage-verging-on-attack.

With a hasty, and rather superficial, adjustment to the stance of admission-of-error, the new arrival plunged on. "My name is Nakrok. I believe you've heard of me, though we've never met."

Indeed he had. Chirr slowly adjusted to reflect acceptance-of-apology while he considered the situation. Nakrok was the chief sponsor of this expedition, and had donated fully half of the broodlings currently scouring the area for artifacts.

"What can I do for you, Broodmaster Nakrok?" His body curled into mild-but-respectful deference.

"I know how important this project is to you, Professor, but I need your assistance urgently."

"My assistance?" Chirr switched to wary-cooperation.

"It will only be for a few days, I promise you, and your mate is welcome to come as well. I've made all the necessary arrangements, spared no expense."

The ornithopter dropped so suddenly into the wilderness preserve that Chirr and Kachinka immediately assumed preparedness-for-sudden-flight, even though there was no place to run to. Their wings were vestigial, ornamental rather than practical, the power of flight long since sacrificed in return for increased body weight and nerve tissue.

"Don't be alarmed," Nakrok reassured them. "We're just avoiding local turbulence."

Chirr's abdomen throbbed nervously and he picked up the conversation to take his mind off the plummeting ornithopter.

"You say you've built some kind of theme park based on the ancient human culture?"

"Some kind of theme park, yes." Nakrok tried to suppress the tremor of triumph in his ventral lobes, but without much success. "But I'd much rather you wait to see it for yourself."

They were on the ground within moments, to Chirr's considerable relief, and disembarked into a waiting centivan. The driver fed his vehicle brush while they climbed aboard, and the two rows of articulated feet tapped restlessly against the ground.

"Rather remote, isn't it?" remarked Kachinka, who still resented being torn from her studies at the archaeological site.

"It's an unusual location, but worth the trouble." This time Nakrok's tremor was much more pronounced.

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They rode in silence, Chirr and Kachinka enjoying the vivid scenery despite their mystification about the purpose of the trip. The steady beat of the centivan's legs was reassuring and Chirr was settling into a mini-estivation when he spotted something moving just beyond the trees to his right.

"Stop the van!"

The driver swiveled an eye stalk toward Nakrok, who signaled immediate-acquiescence. Kachinka glanced at her mate curiously but made no effort to follow when he stepped out of the vehicle. He moved only a few steps, fully upright, before catching sight of something so amazing that he momentarily lost control of his posture and sent a series of contradictory signals to his companions.

"That's a human being!" he said at last. "A living human being!"

Kachinka's head swiveled abruptly as she switched to suspicion-of-levity. Then she, too, spotted the pink creature picking berries from a clump of bushes just a few meters to one side of their route.

"Is it real or a construct?" Her voice betrayed the strain she felt.

"Oh, they're all quite real, I assure you. There are no illusions here."

"They?" Chirr turned to his host, slowly overcoming his confusion to assume respect-mixed-with-skeptical-reserve. "You have more than one of them?"

"Of course. Over a hundred in fact. So far."

"But . . . but how?"

"Let me tell you."

And tell them he did. DNA was fairly easy to come by because of the inexplicable human tendency to preserve their dead in sealed containers. There had even been some success cloning them, although without exception the living bodies that resulted were devoid of self-awareness.

"You've heard of motigen, I assume?"

Chirr nodded. "It's the dynamic fluid manufactured by brain cells that determines which caste we join when we leave broodling stage."

"Well, we theorized that the same mechanism was present in the human species, that it quietly directed each individual into an appropriate cultural role, but that its ephemeral nature made the substance impossible to find under normal circumstances." Nakrok moved into imminent-revelation.

"But you found some anyway?" Kachinka prompted him, displaying curiosity-with-growing-impatience.

"That we did. Quite by accident, actually. One of my construction crews uncovered a buried installation that was still functional. It appears to have been some sort of nuclear powered cryogenic vault, and there were several hundred intact human bodies preserved inside. We think it was either a museum or some kind of strange religious cult. In any case, the important thing is that we found traces of motigen in most of the braincases."

"But surely it would have deteriorated with the passage of so much time. The human species has been extinct for thousands of brood cycles."

"None of the samples were undamaged, but by comparing what survived from one to another, we were

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able to run computer simulations that allowed us to extrapolate the missing data. We used surgical viruses to fill in the gaps and then began experimenting with bodies cloned from human DNA. Two years ago, we had our first success, and using accelerated growth techniques, we quickly populated the park. These," he gestured toward two browsing humans, "are primitive experiments whose motigen was flawed. They can do little more than forage. But our recent arrivals are much more advanced. The insurance salesman even seems to understand simple body postures and spoken language."

Chirr felt suddenly faint. "Insurance salesman? You have an insurance salesman?"

"Why, yes. We bred him right after the real estate agents. We plan a full range of attractions."

Chirr and Kachinka were lost in their own thoughts as their journey resumed, and they became aware of their surroundings again only when the centivan paused before the towering gates to the main park. Above them, the silhouette of a bare-chested human figure had been painted onto the rightmost gate, both fists poised to pound a challenge on its obscenely hairy chest. On the opposite gate, a sign read simply: THORACIC PARK.

Chirr and Kachinka recovered some of their wits while being introduced to Grackl, whom Nakrok introduced as his game warden. "Grackl tells me when I'm taking foolish chances, you see. I have a tendency to get so involved with my work that I forget how dangerous these creatures are."

"They don't seem to move very quickly."

"No, the fastest ones are the lawyers, and then only when we give them an ambulance to chase."

Chirr was shocked. "Lawyers? You've bred lawyers?"

"Why, certainly. They were one of the most common breeds after all."

"And the most dangerous."

"That adds to the park's atmosphere. But we're actually quite safe. Each section of the park is surrounded by thornfire bush. In fact, we had to give the roots a mild local anaesthetic in order to open the main gate. They're quite well contained."

"But what if something happened?" Kachinka switched to alarm-with-mild-accusation. "What if they got out? Their breeding capacity is enormous. That's what eventually destroyed them; they outran their food sources and their culture collapsed." Chirr's mandibles trembled at the very thought.

"No fear of that either. I assure you we've taken every precaution. The inhabitants of Thoracic Park are incapable of breeding. We've made sure of that."

"But how?" demanded Chirr. "Those two we saw on the way in. Didn't you say they were of different sexes?"

"Yes. But we've biologically altered them to prevent breeding. The humans were very much visually oriented in their sexual habits, you see, so we've made certain that they're all very ugly."

They met one more member of Nakrok's staff at the park headquar-

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ters, a surly, overweight individual named Frell whose every posture included at least a hint of impatience-with-trifles.

"Frell is unhappy with me," Nakrok admitted later. "He's a contract botanist I hired to oversee the thornfire planting, and I'm afraid he underestimated the acidity of the soil. But a contract is a contract. He's spun his web and now he'll have to sleep in it."

"You said you had some kind of automated tour set up for us?"

"Yes, indeed. We're just waiting for the others. Ahh, here they are now!"

Chirr shifted to growing-unease-and-anticipation-of-distress when he saw the broodlings emerge from a nearby building. Fully six score of them, all exuding the same clan pheromone as did Nakrok himself.

"This is my most recent brood. They'll be accompanying you on the tour."

Chirr felt his posture shifting more definitely toward distress but Kachinka touched her antennae to his. "Steady. You can put up with them for a short time."

He supposed she was right, but he didn't have to like it.

The tour was not a great success. The real estate agents were too busy drawing lines in the soil and arguing with each other to pay attention to the tour van. The night watchmen were nocturnal and currently asleep, the accountant sat with his back to them, slowly moving stones from one pile to another, and the hairdresser was sick and sedated.

Then they reached the exterminator's compound. Chirr and Kachinka peered through the ropes of thornfire bush but the dreaded creature, a monster whose name was used by broodmasters to frighten broodlings into behaving themselves, was nowhere to be seen. Chirr would have welcomed its presence for more than professional reasons. Nakrok's broodlings were full of nervous energy, kept running across the ceiling of the van as well as the aisles, and were generally making nuisances of themselves. A little scare might help keep them in line.

If he'd known what was happening back at park headquarters, he might have altered his wish.

Frell assumed acceptance-under-protest and ended his interview with Nakrok, even though the posture had not reflected his true feelings. It was clear that the broodmaster would not agree to compensate him for the extra expenses he had incurred, and that in the ordinary course of events he would be compelled to dismember himself to appease his creditors. But Frell had a contingency plan.

He returned to his workroom and retrieved the vial concealed in an innocent bottle of mandibular cream, then filled a syringe and walked out onto the grounds. The nearest thornfire bush was only a few meters away. With a quick look around to make certain he was unobserved, Frell injected a contagious virus into the largest strand of thornbush within reach.

Within an hour, the entire thornfire containment system would be rendered temporarily inert. Frell already had samples of various strains of moti-

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gen concealed in his egg sacs. Once he reached the mainland, he'd sell them to one of Nakrok's rivals.

Unfortunately, Frell didn't know that his virus also affected the centivans. He would learn the truth shortly, when his stolen vehicle fell into a coma and left him at the mercy of a hungry laundromat attendant.

Chirr was too preoccupied to notice the first irregularity in the centivan's movement, but Kachinka picked it up right away.

"Something's wrong with our vehicle," she said quietly.

Sure enough, they were jolted almost immediately as a half dozen legs folded and collapsed on one side. The remaining ones thrashed for a few more seconds before falling silent as well. The broodlings began to screech, some annoyed, some frightened.

"Is it dead?"

"I don't think so." Kachinka inclined her antennae toward a set of exposed ventricles. "It's still breathing."

"What do you suppose happened?"

She curled into the posture of confusion-and-mild-concern. "I suppose it might be sick."

Chirr was about to make an intemperate remark when one of the broodlings swarmed up his body and clamored for attention, gesturing with one arm toward the containment line.

Something was struggling to emerge from the thornfire bush. "That's impossible!" Chirr's whispered protest was loud enough to send the broodlings into another furious race up and down the inner walls of their vehicle.

But there was no question that the human exterminator was making its way steadily forward through the barrier, brushing the thornfire barbs aside with frightening ease.

"We can't wait for this thing to wake up," he said quietly. "We're going to have to make a run for it."

Kachinka glanced meaningfully at the horde of broodlings swarming around them.

"Yes, I know. But we don't have any choice."

"All of them?" Nakrok glared at the biotechnician. "Are you saying they're all inactive?"

"Yes, sir." The technician didn't look happy. "Somehow they've been contaminated with a contagious neuro-agent. There are several strains of virus that would have this effect. Frell's an expert on viruses. I'm sure he can find a counteragent as soon as we've located him."

Grackl entered the room at that moment, assumed the posture of frustrated-lack-of-success. "He's nowhere within the headquarters area, and one of the centivans is missing."

Nakrok's mandibles clenched with anger. "Well, we'll have to make do without him then. You!" He pointed directly at the technician. "Isn't there a general serum we can use to get the thornfires back on line?"

But before he could answer, one of Grackl's staff burst into the room with more bad news. "The lawyers have broken out of their pen!"

Grackl twisted into extreme-rage-with-overtones-of fear. "If they escape

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into the main park, we'll never catch them. They're the cleverest of the lot."

"They're not headed for the park. Noctor saw them breaking into the library."

"The library?" Grackl turned to Nakrok, who slowly curled into admitted-lack-of-answer.

Chirr and Kachinka led the broodlings into a small cavern for the night. "Don't worry," she reassured the young ones. "They're modified tree dwellers and won't come down after us." She felt less confident than she sounded.

"What do you suppose happened?" Chirr was still shaking from the exertions of the day. They'd evaded the exterminator with some difficulty, encountered what appeared to be an immature butler dusting the leaves in a fern grove, and were briefly chased by a pair of letter carriers before eluding them in a swamp.

"I have no idea. The park security system must have malfunctioned. I'm sure they have parties out looking for us, but the park is so big, I think we'll have to make our way back on our own."

And so they did, over the course of the next day, arriving in sight of the headquarters compound just as the Sun was starting to drop behind the nearby mountains.

"Everything looks quiet," Kachinka observed quietly. They were crouched on a knoll, staring down into the cluster of buildings.

"Too quiet. Where is everybody?"

"Out looking for us?"

In the cramped space, it was difficult to assume skepticism-with-hope so Chirr compromised on uncertainty-with-anticipation.

"Well, we can't wait here. Let's go."

Chirr led, followed by a double column of broodlings, with Kachinka following to make sure none of the young ones strayed. They crossed the cultivated grounds without incident, reached the entrance to the main hall.

"I'll take them inside," Kachinka offered. "You find out where everybody is."

Chirr inclined into acceptance-of-suggestion and waited only long enough to assure himself that the last of the broodlings was accounted for before proceeding.

The estivation room was empty, the feeding hives abandoned, the centivan nest quiet. Chirr passed them by and headed for the park control room, convinced that it would be occupied even if everyone else had been evacuated.

Grackl hailed him as he approached, rushing out into the open to embrace Chirr with intertwined antennae. "You've survived! And the others?"

Chirr explained quickly. "What happened?"

Grackl shifted rapidly through a number of postures, conveying confusion, anger, fear, uncertainty, and a host of other unpleasant emotional states.

"The thornbush was deactivated. We've just managed to get an antidote flushed through the system."

Chirr allowed himself to relax slightly. "Then the humans are back under control?"

"Most of them." Grackl turned an

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eyestalk toward the control building. "But the lawyers escaped and got into the library. They barricaded the doors, killed and ate poor Skrezzle, and it was pure luck that we were able to surround the place with revived thornfire before they broke out."

"But they're confined again, aren't they? So why do you appear so distraught?"

Grackl's body slumped into resigned-to-disaster. "They're smart, you know, smarter than we thought. All this time we've been studying them, they've been studying us as well. It seems they've picked up enough of our language to use the library, and they spent the last day reading."

"So what? They're just animals, aren't they? It's not as if they can understand what they read."

"That's just it. They discovered an obscure law under which they are legally an endangered species, and by the provisions of that law, we can no longer confine them to a prescribed habitat. We have to let them go free." He assumed the posture of concern-mixed-with-relief. "At least they won't be able to breed."

In a remote part of Thoracic Park, two ugly-faced humans closed their eyes and made love. ■

If hard work were such a wonderful thing, surely the rich would have kept it to themselves.

—Joseph Lane Kirkland

You have to accept whatever comes and the only important thing is that you meet it with the best you have to give.

—Eleanor Roosevelt

All things are possible until they are proved impossible—and even the impossible may only be so as of now.

—Pearl S. Buck

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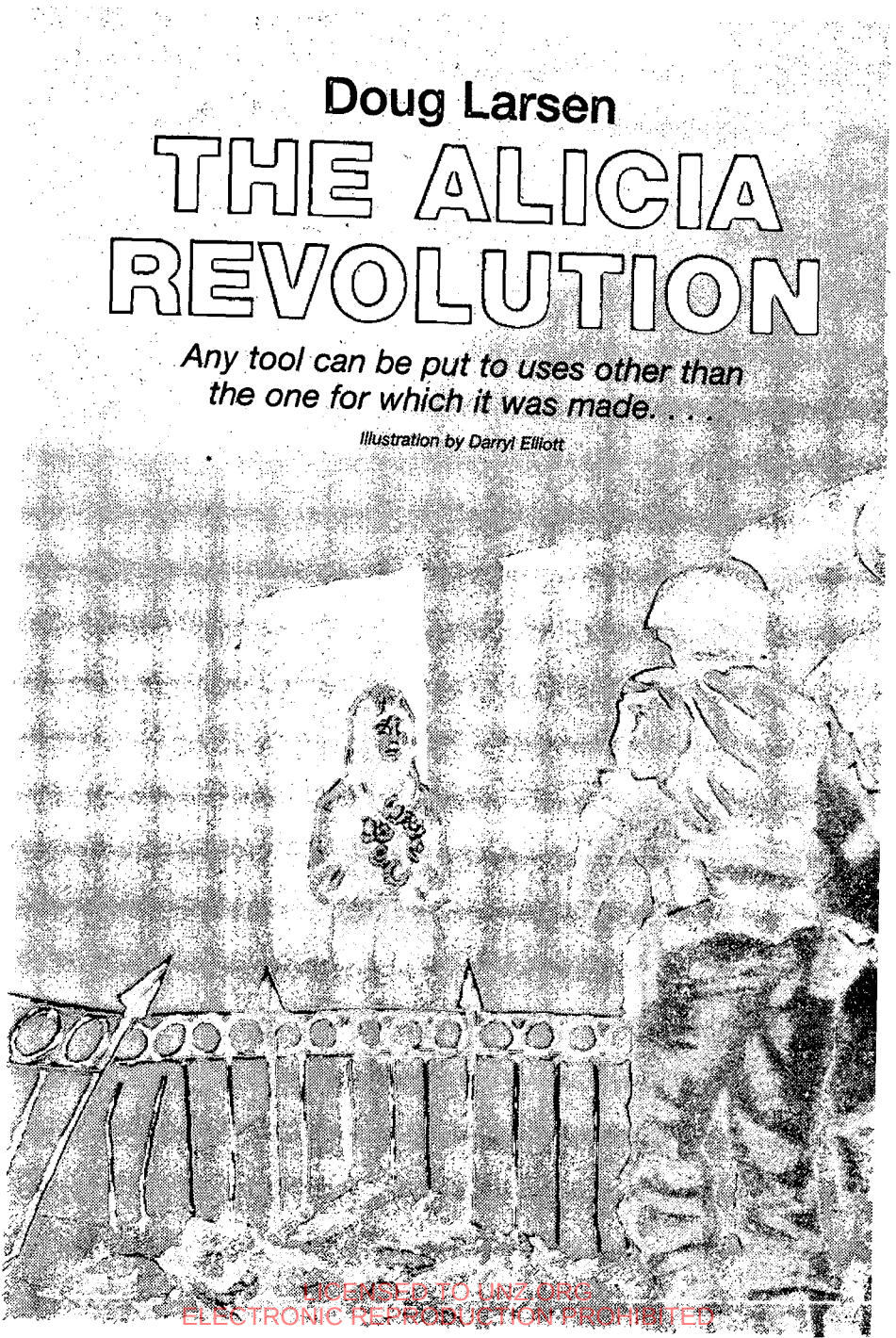
Doug Larsen

THE ALICIA REVOLUTION

Any tool can be put to uses other than the one for which it was made. . . .

Illustration by Darryl Elliott



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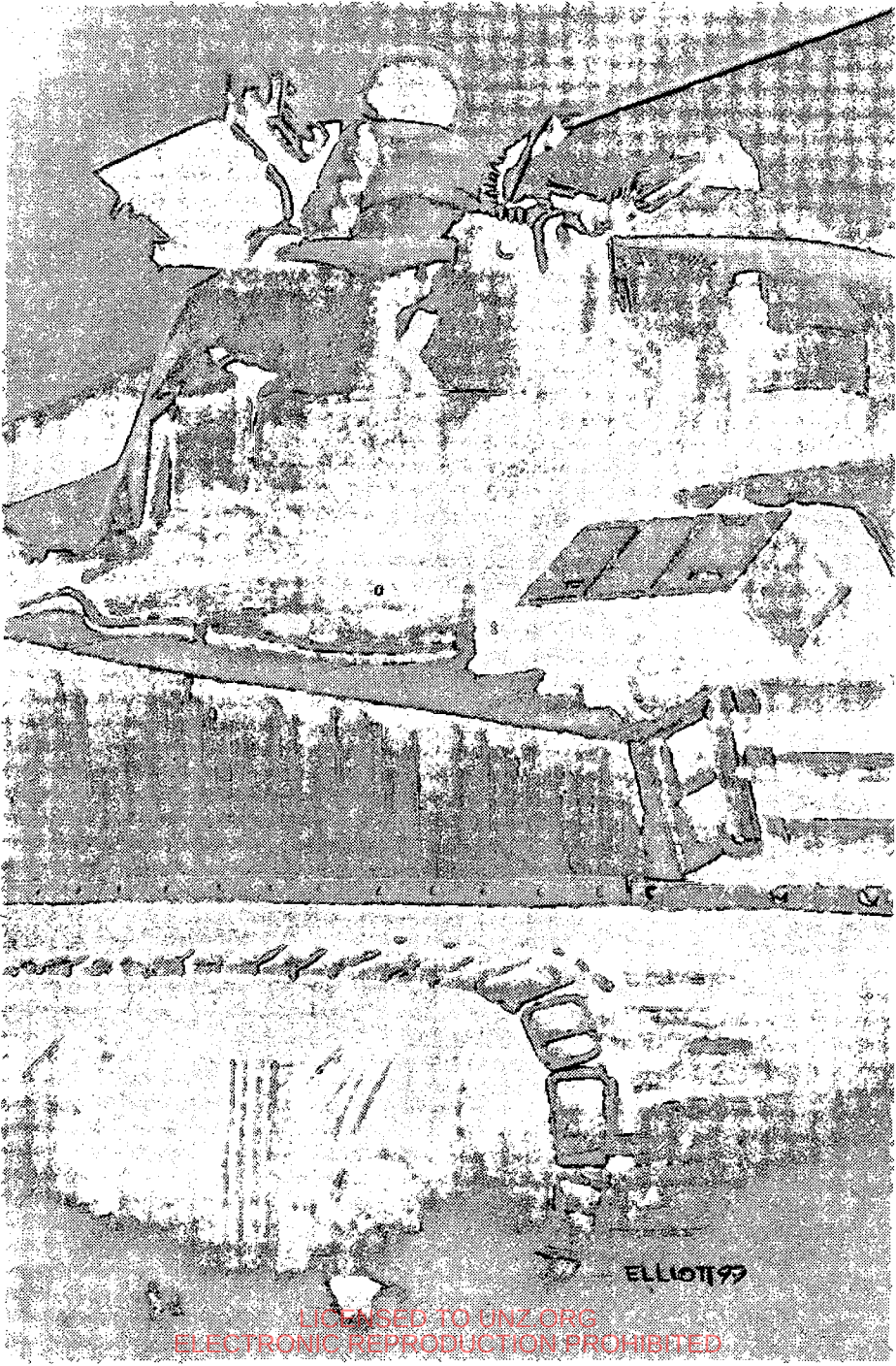

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I left the United States about two steps ahead of my creditors, and one step behind financial ruin. I gazed around the grimy, rundown airport in the capital city of Thusbammanna, and wasn't sure if I had come out ahead in the deal.

I made it through immigration with no problem. The passport official gave me a funny look, but I ignored it. American tourists probably attract a lot of curiosity in these tattered Third World countries.

The luggage rack was about ten feet away, but that didn't mean that my bags appeared quickly. It took twenty minutes or more, which is ridiculous, considering my plane was the only one that had arrived. I grabbed my bags in pure exasperation, and turned to find customs and the car rental counters. I almost ran into a uniformed official.

"Excuse me," I said, and started to go around him. He moved to block me, and I saw two burly guards behind him. Uh-oh.

"What's going on?" I asked apprehensively.

"You are Jane Anderson?" the officer asked.

"Yes. What's going on?"

"I am an agent of the Thusbammannan security forces," he said. "Please be kind enough to follow me."

"What's going on?" I parroted stupidly, but followed him.

He led me to a private room, and sat me in a chair. He sat down facing me, and consulted a computer printout of some kind.

"You are Jane Anderson?" he asked again.

"Yes, I am. Will you tell me why you're interfering with me?"

"Are you familiar with a man named Kenneth Anderson?" the man pressed on.

Oh, my God. None of us had had any idea things would have gone this high. I blessed my dad for his almost offhand warning. "Don't admit to knowing me, Jane," he'd said. "There's an off-chance they'll remember me." An off-chance, he'd said! After ten years, it had only taken the police twenty minutes to red-flag my passport! "No," I said coldly, lying through my teeth. "Why do you ask?"

"He has been identified as a subversive force by the government of Thusbammanna. He has been declared *persona non grata* in this country. This designation includes any of his associates or relatives."

"How does that apply to me? I don't know the man."

The official consulted the printout. "You have the same last name," he informed me. "You are from the same state in America. You are of the appropriate age to be his daughter."

The Thusbammannan security forces certainly had their act together. But I had rehearsed this. I waved my left hand, showing my wedding ring. "I'm married," I said simply, and added another lie. "My maiden name is Johnson." I hoped that Thusbammannans weren't familiar with the growing American trend of married women keeping their maiden names. "And in my state, there are several million people named Anderson. It's not exactly unique."

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"May I ask why you are visiting our country?"

"I'm a tourist," I lied again. "What's the problem? I thought you were trying to attract tourism."

The official stared at me for a moment, and then a door opened and another man came into the room through a door that had a mirror near it. The official looked at him, and the man nodded slightly. The official turned back to me, and broke into a wide smile.

"My apologies for the inconvenience," he said warmly. "We are delighted that you have decided to visit us. This man whom we have mentioned was a dangerous man, and we were thinking only of your safety."

My dad was about the most mild-mannered man alive, but he always seemed to get a kick out of having scared this government silly. I smiled at the memory, and the official mistook it for friendliness.

"Allow me to assist you to your destination to compensate for the inconvenience," he urged.

"Thanks, but I just need to rent a car."

"Pah! Come with me, and I will assure you of the finest car, and ensure that you do not have to wait in line!"

Now the official was all warmth and friendliness, and he made good on his promise. In no time at all, I had a rental car—a full-sized American model, at the subcompact rate. I wasn't proud—I took it, and was glad.

The official loaded my luggage into the trunk, and held the door open for me. "Observe the excellent facilities we offer tourists to our country!" the official exclaimed, indicating the little touch screen mounted in the dash. "A directional computer, very easy to use! You simply program your intended destination, and the computer will give you directions on how to reach it. If there is traffic congestion, the computer will offer directions on how to avoid it. If you are intending to reach a hotel, the computer can easily reserve a room for you as you drive. May I demonstrate how it works?"

"Thanks, but I'm familiar with them," I said politely. We'd had them in my state for over five years, and I was so used to them that they were about as remarkable as air conditioning. I endured his warm farewells, and drove off. I had the computer programmed to direct me to a hotel my dad had recommended, and had it reserve a room for me before I even left the parking lot.

It was quite strange using the computer direction system. I was so familiar with my city that I rarely used it, except to check on rush-hour traffic. But in a strange city, clogged with cars, it was very useful—especially since the synthesized voice was in English. "Turn left here," it instructed me. "Proceed on this road for three kilometers." I obeyed, watching my odometer. Right before it showed that three kilometers had passed, the voice said, "Turn right at the next corner."

Since I only had occasion to drive in my own city, I never had the chance to give the computer-aided driving system a full test. I was impressed with how thorough it was, even though I could tell it was a rela-

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tively old software release. The new systems would have made sure I was in the right lane before telling me to turn right.

Thusbammanna, I observed, was a country that was still wallowing in abject poverty. Slums were everywhere, although once in awhile I drove past an enormous estate, complete with an iron fence surrounding it. People were engaged in the most menial jobs you could imagine. The only thing that didn't match was the large number of later-model American cars. Compared to the human suffering that was apparent everywhere, the cars struck a discordant note.

I wondered bitterly about the priorities of a corrupt government that would spend money on a computer-aided driving system while its people were so poor. As if tourists would want to come to this run-down country! But then, my dad had come here ten years before, to help them grow chrysanthemums, of all things, while the people starved. The flowers generated hard currency. And crops only fed the people, which was real low on this country's priority list. I supposed their effort into tourism was based on the same philosophy.

"Bastards," I said out loud. This country was not a good place to come if you were already filled with bitterness, because the plight of its people would only add more.

I checked into the hotel, and went up to my room. It was new and modern; part of Thusbammanna's effort to attract tourists and their hard currency, if my dad was right. I flopped down on the bed and stared at the ceiling. Why had I come to Thusbammanna in the first place?

I had no good reason. I only knew that this was the place my dad, Ken Anderson, had come as a volunteer. He had gotten involved in a project to help the starving people of Thusbammanna develop a method of growing food without farms. The project had been successful, and had gotten him expelled from the country. He'd code-named it the Alicia Project, after my mom, who had died just before Dad came here. Her death just about killed him, and his stay in Thusbammanna had brought him back to life.

I smiled bitterly. Maybe that was why I was here. Maybe I was hoping that Thusbammanna would bring me back to life, the way it had for Dad.

Not that I had anything as bad as Dad had. My relationship with my husband Duane was OK—kind of strained, but that's to be expected when you're both in full-scale war with a teenaged son, I guess. I still felt guilty about leaving Duane with his hands full, but I just could not stand fighting with Tom again. Or dealing with my daughter Alicia, named after my mom. She was ten years old, and idolized her rebel brother.

But I suppose I could have stuck it out with all of that, if my business hadn't gone bankrupt and I hadn't been accused of fraud. My lawyer said that if I wanted to clear my name, I was looking at a year-long court battle. All of that, just to prove that I had no connection with the client that had cheated me and several other people.

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I was tired out. I was bitter. I needed to recharge my batteries, but I didn't think I could have picked a worse place to do it. The Thusbammannan government was still gunning for my dad. His old contact here, a man named Chantlo, had told him that the government had resorted to increasing brutality, clamping down harder and harder on the people who wanted to reinstate their elected government. The elected president had fled to the United States, where he was trying to get American support for his return. America was sympathetic, but reluctant to do much about it because Thusbammanna had a US Air Force base.

An underground had formed in the country, trying to protect the people from the military strongman's brutality and starvation tactics. The underground was also trying to engineer the return of the elected president, but no one seemed to have any ideas as to how that could be done. My dad had supplied one of their most effective activities, in the form of spreading the food technology that was eradicating starvation from the country.

And here I was, right in the middle of the mess.

My dad had talked about Thusbammanna with such love and affection that it seemed like a magical place to me. He had been delighted when I mentioned that I might go there, and seemed sure that the country had some kind of mystical balm that would heal me, too. Duane had been markedly less enthusiastic, but I just had to get away.

Out the window of the posh hotel, I looked down on several blocks of squalid slums. And this place was going to "heal me too." Yeah, right. I wasn't like my dad. There wasn't anything I could do to help these people, and there was nothing they could do to help me.

I wondered if I would be charged for the hotel room if I checked out immediately. I quickly got up and straightened out the bedspread. I found the little list of rules, screwed into the door as in hotels all over the world. Like everything else in the nice sections of Thusbammanna, they were in English. I bent over and started scanning for the billing rules. Suddenly, someone knocked on the door, just inches from my head. Yikes! I jumped a foot, and took a second to catch my breath before I peered through the peephole. A uniformed waiter or porter stood there, looking down the hall. He raised his hand to knock again, and I quickly opened the door.

"Yes?" I asked, barely able to muster any civility.

"Mrs. Jane Anderson?" he asked.

I jerked in surprise. "Yes?"

"A message for you, madam." He handed me a slip of plain paper.

I unfolded the paper. Some words were written on it—maybe an address or something. I stared at it uncomprehendingly.

"I don't understand," I said.

He looked at the message helpfully. "It is an address, madam," he said pleasantly. "I am sure that if you were to show that to a taxi driver, he would be able to transport you there."

I stared at him. "Why would I. . . ?" I

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trailed off as I saw that he was showing me something cupped in the palm of his hand. I looked down and saw a photo of my dad. I stared at the porter with my mouth open. "Wha—"

"Thank you madam, but I am not allowed to accept gratuities," he interrupted loudly. Then he winked at me, and walked away.

I staggered back into my room and looked around wildly. What was going on around here? I gazed blankly at my suitcase. I could be on a plane back to the States in an hour, and none of it would matter. Why didn't I do that?

Why didn't I just leave?

I had no idea. But for some reason I walked down to the main entrance of the hotel and asked the doorman to get me a taxi.

After driving in a dizzying route through the most congested parts of the city, the taxi driver stopped at a street corner. All around was some sort of farmers' market, with hundreds of booths and thousands of people. Completely at a loss, I shoved a wad of money at the driver. He smiled kindly, shook his head, and took one of the bills in the wad. Then he made change, and handed it to me with a broad smile.

At least that was something that resembled my dad's description of the country—they were kind and honest people. I smiled back at him, and gave him back one of the bills in the change for a tip.

I scrambled out of the cab and stood in the teeming crowd, feeling very lost and very American. I jostled my way slowly through the flood of humanity toward one of the booths—it was selling vegetables. Maybe I'd ask for advice from the people there.

"Jane Anderson?" a voice inquired softly in my ear.

I nearly jumped out of my skin. I whirled and looked at a tall man in his fifties. "Wha—Who—"

"What is the name of your child?" the man asked sharply.

I stared at him. *"Chantlo?"* I gasped.

"Please tell me what your child's name is!"

I finally figured out that this was some kind of identity check. "I have two," I said swiftly. "Tommy and Alicia. My husband is Duane. I ran a software business until it went bankrupt two months ago."

He relaxed a little. "And what did your daughter do in church to embarrass you when just a baby?"

I laughed in spite of myself. "She went potty on the pastor's shirt right before the service."

The man flashed an enormous smile, and shook my hand. "Mrs. Anderson, I am Chantlo. It gives me great pleasure to finally meet you."

"Me too. I've heard a lot about you. How did you know where to find me?"

Chantlo was pulling me through the crowd as he spoke. "One of the guards at the airport is a member of our resistance movement. He took your picture through a one-way mirror. When he had the opportunity, he passed the word that you had arrived in our country. Then, when one of the hotel clerks reported your arrival, we located you without difficulty."

"Wow. You guys have quite a system."

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"Let me assure you, Mrs. Anderson, the security forces have a far superior system. Your picture is in the hands of every security agent in Thusbammanna."

"Yikes!" I followed him blindly, wondering if it would be possible to tell him that I was heading to the airport to get out of here.

"It is most fortunate that you have arrived," Chantlo continued. "Your presence at this time of crisis gives us hope."

"Crisis!" I yelped. "Wait a minute!"

"Your father's conspiracy has yielded great results," Chantlo said as if he hadn't heard me. "The people, with better and more reliable nutrition, are better able to plot and plan and fend for themselves. But meanwhile, the government has launched a major offensive against the resistance, and is on the verge of smashing the entire network. The people sense the danger, and events may soon explode."

"Chantlo!"

"Quickly, Mrs. Anderson, into this car!"

I got into a waiting car, and he drove off quickly.

"Chantlo, listen to me!" I insisted.

"Yes, Mrs. Anderson?"

"I'm just a bankrupt computer programmer!" I protested. "I don't know anything about revolutions or conspiracies! I came here because I was hoping you'd make me feel better!"

He looked at me. "I do not understand. 'Make you feel better'?"

"Yeah!" I said defensively. "Like you did for my dad! He showed up sad and forlorn and defeated. You sent him back, healed and full of life. Do the same for me."

Chantlo looked at me out of the corner of his eye. "You are a person with good health, with never a fear of starvation. You live in a country where citizens are treated with dignity and respect. You do not live in fear of violence or repression. Surely you feel better than anyone in Thusbammanna."

"But I don't, all right? I can't take care of my own problems, much less help you in some revolution! I just want to get back on an airplane, and go home! It was a mistake to come here!"

Chantlo drove in silence for a moment. "This is not the way our esteemed friend, Mister Anderson, would have done things."

"I'm not Mister Anderson, all right?" I snapped. "I'm his daughter. I even have a personality of my own."

Chantlo took the rudeness in silence. Then he spoke fondly. "Mister Anderson was a very gentle, giving man."

"He still is," I said with annoyance.

"And his late wife," Chantlo probed tentatively. "The woman who is nearly deified in our country, his Alicia—she was as well?"

I laughed shortly, without humor. Talking about my mom is very painful for me, even this many years away from her death. "No, that's not how I'd describe her."

"No? Indeed?"

"No. She was little and tough and fiery. She never took crap from anybody in her life. Dad says I'm a lot like her."

Chantlo looked almost disappoint-

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ed. "I have never imagined her that way. I have only seen her through your father's eyes, and he saw her differently."

"Don't misunderstand," I said. "She was the finest woman I've ever known. But she wasn't at all like my dad. He gave her the stability and calm that she needed. And she gave him the energy and confidence that he needed."

"He seemed lost without her, when he was here."

I dabbed at my eyes. "They both knew what they had."

Chantlo opened his mouth to ask something else, but I interrupted quickly. "I'm sorry, but I don't want to talk about this anymore, OK?"

He nodded, and we drove in silence.

Talking about my mom is always tough for me. There was never anyone in the world I respected as much. She was never afraid of anything. I liked to think that I was a lot like her.

Except now, of course—running away when things got tough. *Oh, God, I'm just not up to this,* I thought with a rush of self-pity.

I took a deep, shaky sigh. "All right, Chantlo," I said. "How can I help?"

We ended up driving toward Chantlo's house. "Please understand, Mrs. Anderson," he explained, "I do not know how you can help us. But your very presence gives us hope."

"Why? What's going on?"

"Up until recently, the resistance movement flourished, thanks in large part to the underground nutrition system established by your father. We were able to better care for our people, and warn those who are in danger. We also attempt to document human rights abuses and get this documentation into the hands of your government. We are attempting to make a case for American support of our resistance movement, to encourage the resumption of free elections. This, of course, causes concern on the part of the corrupt military dictatorship. They are growing wealthy at the expense of our people, but they are having more and more difficulty with a populace that is less and less docile. Their response has been increased brutality, and a sophisticated assault on the leaders of the resistance movement. Many of our leaders have been executed, others are jailed, awaiting questioning. The duly elected leader of Thusbammanna fled to America when overthrown by the current regime of cutthroats, so he is safe. But those attempting to change everyday life in Thusbammanna are living in great danger."

I digested this in scared silence. Chantlo turned into a poor neighborhood, and pulled up at a tenement house that I assumed was his home. We went inside.

"And here you find another reason I consider your arrival to be fortuitous," Chantlo said. "Please allow me to introduce two people who may be already familiar to you." He indicated two women; obviously a mother and daughter. The mother was about my age, and the daughter about my son Tommy's age. "You remember your father telling of the little girl he rescued?"

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"Sure," I said, the light beginning to dawn.

"This is the girl! And her mother, of whom you must also have heard. They are visiting relatives and friends in the city."

I shook hands warmly with them. The mother, whose name was Marina, was all smiles and grace. The little girl, named Anya, was now a teenager, and not as welcoming. I found it strange that after all of the stories my dad had told of this family, this was the first time I ever learned their names. Dad had never known.

"I'm very pleased to meet you," I told them.

"Hello, very pleased," Marina said. Anya only eked out a thin, sullen smile.

"Marina's English is not as good as those of us in the city," Chantlo explained. "Her daughter can speak English more proficiently."

"It's better than my Thusbammannan," I answered. I looked closely at Anya. There was still very faint distortion of her features here and there, a result of the rifle beating she had received at the hands of soldiers ten years ago. But she was obviously healthy, and very obviously possessing a teenaged attitude.

Marina nudged her daughter and said something to her in Thusbammannan. Being a mother, I knew for sure that Marina was reminding Anya of her manners. Anya just rolled her eyes and shrugged.

I looked at Anya with complete recognition. *I have a son your age,* I thought at her. *I can't do a thing with him, either.* I'd had more than my share of that crap, so I turned to Chantlo. "Please tell them that I'm very glad to meet them," I asked politely.

"You must, of course, stay for dinner," Chantlo invited.

I didn't really want to, but I knew how impolite it would be to refuse.

Dinner was interesting and tedious at the same time. People dropped in to meet me, for word had spread that the daughter of the originator of the Alicia Project had come. I enjoyed that, but Anya was a continual cloud of sullen gloom that hovered over everything. She didn't say a word the entire time, refused to interact, and just generally acted like an adolescent bitch. I stopped myself. She was just an average teenager, no worse, and I was being harsh because my son had exhausted my patience. And I needed to make allowances for the fact that she had been brutally beaten when she was very young. I didn't suppose that Thusbammanna offered any kind of counseling to help children recover from that kind of trauma. It was probably amazing that she was functional at all.

Realizing this, I surprised Anya with a smile. She looked startled, and almost smiled back, but remembered herself in time and merely looked aloof. It was amazing. A different country, on a different continent, and teenagers were still the same.

I went back to the hotel to get some sleep, but wasn't terribly successful. A lot had happened to me, and a lot looked like it was about to happen. A thousand feelings, all conflicting, coursed through my brain. I slept

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badly, and was relieved to see the dawn.

I grabbed breakfast in the hotel dining room, and decided that since I had paid attention in the taxi the day before, I could find the way to Chantlo's house myself. I climbed into my big American car, entered Chantlo's address on the computer, and headed out.

It was a short distance away physically, but economically it was another world: a very poor, depressed area, filled with people and disintegrating homes. I pulled in, and noticed a lot of commotion going on at Chantlo's little tenement house. I got out with a growing sense of trepidation.

The first person I ran into was Marina, and she was beside herself. "What's going on?" I asked, feeling like that was the only thing I had asked in Thusbammanna.

"The family!" she cried, tears running down her face. "The soldiers, they take!"

Oh my God—I didn't know what that meant, but it sure sounded bad. I hurried in, and saw Anya sitting huddled in a corner of a bedroom. She looked at me with hostility and fear, and wouldn't respond to anything I said. I ran to another room, and found Chantlo. He was quite upset, running from room to room, calling out in a loud voice. I grabbed his arm, feeling the hysteria of the place rubbing off on me.

"Chantlo! Chantlo, for God's sake, what's going on? What's wrong?!"

"Oh, Mrs. Anderson! It is terrible! Truly terrible! The security police came this morning, when I was not here! They intended to arrest me on suspicion of treason. But, as I was not here, they took my family instead! My wife! My poor children! They are in prison as we speak! They allowed Marina and Anya to stay, and instructed them to inform me that my family will be released only when I turn myself in! Oh, Mrs. Anderson! This is terrible!"

I was struck speechless by the enormity of the situation. Based on my dad's stories of the Thusbammannan security police, I knew that Chantlo would probably be tortured, questioned, and then executed. And if he didn't turn himself in, it would probably happen to his family.

"OK," I said as calmly as I could. "OK. Let's sit down for a minute and see if we can find a way out of this."

"There is no way, Mrs. Anderson. Imagine the fear of my family! Imagine what will happen to them if I do not turn myself in within twenty-four hours!"

I didn't want to imagine what would happen, although I had a pretty good idea. "Do you have any benefit of counsel? Anybody who looks after your rights in this matter?"

He looked at me like I'd lost my mind.

"Sorry," I said. "I'm new to this."

"Please, Mrs. Anderson," he said urgently, "could you drive me to the police station?"

"Chantlo, are you sure about this?"

"Yes, Mrs. Anderson. I will not allow my family to be brutalized because of my absence."

"Well . . . OK," I said miserably.

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"Would it help if I spoke for you?"

"Certainly not. It would merely confirm their suspicions."

"OK. Well, I'm ready when you are."

We walked to the car in silence. I sat for a moment. "Why do they want to arrest you?"

"I do not know why they suspect me. I may have been seen attending some high level resistance meetings, but I am not sure. This is what has been happening to resistance members all through the country."

"How could they know where you were?"

Chantlo shrugged. "I can only presume that the security police have followed me. But I must confess to great confusion. I do not understand how anyone could have followed me without being discovered. I have been extremely careful."

I started the car, and hit the "No Option" button on the computer system. I wouldn't need it with Chantlo here. "So we're screwed," I concluded.

"I am afraid so."

"So you have to turn yourself in?"

"It is my only option," Chantlo said bitterly. "I can not endanger others to protect myself. I certainly will not endanger my family."

I had pulled out to the intersection of a major road, and waited for Chantlo to tell me where to turn. I looked at him, but he was shrunk into himself, deeply depressed. Tears were welling into his eyes. I felt great sorrow and sympathy, but didn't know what I could do. I could at least respect his privacy, and use the computer to get us to our destination instead of bothering—wait a minute.

"Wait a minute!" I exclaimed, and wrestled the car violently to the side of the road. Chantlo looked up inquiringly, but with no life in his eyes. "Chantlo!" I yelled at him, even though he was two feet away.

"Yes, Mrs. Anderson?"

"Do all of the cars in Thusbammanna have these directional computers?"

It obviously took every ounce of his strength to remain polite in the face of such a trivial question, but he managed. "Virtually all, Mrs. Anderson."

"But surely the people can't afford them."

"It was a government program," Chantlo said, his voice revealing a burr of exasperation. "The technology was imported from the United States to reduce the congestion and pollution in Thusbammanna, and the government had them installed in all of the cars. I am sorry, Mrs. Anderson, but I do not see—"

"But that's it!" I cried. "That's how they followed you!"

"What?"

I stomped on the accelerator and screamed out into traffic, Chantlo holding on for dear life. "Where are we going?" he called over the sound of the revving motor.

"Back to your home," I said. "We've got work to do!"

"I must protect my family," Chantlo objected. "I *must*—"

"Bullshit!" I interrupted rudely. "I know how to get them out of jail, without putting you in!"

He stared at me with wild hope rising in his eyes. "You suddenly remind

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me much of your father," he said, not knowing how much of a compliment he was paying me.

"Thanks, but let's wait to see if it works."

"I beg you to explain your idea."

"It's these directional computers," I said. "They're installed as a driver's aid. But, see, the computer in each car is in contact with a main server somewhere in your city. That's how your car's computer gets its sense of direction; by checking with the main server. That's why, if you go to the country for a day, the computer can't help you because it's out of range of the server, but when you come back into the city limits, the computer knows where it is. It checks with the server."

"I have heard of satellites that can give any car an accurate location," Chantlo said. "Why is a central computer necessary?"

"Satellites would work fine for individual cars, but the central computer does a lot for metropolitan areas. It monitors the location of thousands of cars simultaneously, which makes it possible to forecast and minimize traffic jams. That's why."

"I see. Please continue."

"Well, the level of detail of your directional computer's instructions means that it's got to keep track of where you are at all times. I mean, if it says, 'turn left at the next corner,' it's got to have a pretty specific idea of where you are when it says it, right?"

"Yes," Chantlo prompted again.

"And if the central computer is going to calculate what roads have congestion, they calculate how many cars are there, and their speed. The central computer also sends out general queries, asking if there are any cars heading for the congested areas. If your car's computer is programmed for that area, it answers 'yes,' and the central computer can forecast how much better or worse the congestion is going to be."

"But how does this help me?" Chantlo asked.

"Well, don't you see? *The main computer server knows where every car is! The government can tell every place you've driven to!*"

Chantlo stared at me with comprehension and horror rising in his face. "My . . . my God!" he stammered.

We drove in silence for a minute while I let him digest the information. Finally, he stirred.

"And so this explains the success of the government's crackdown of the resistance movement," he said. "They track the driving activities of everyone suspected, and know of their whereabouts."

"Right."

"But Mrs. Anderson, I am familiar with this city. I rarely use the computer."

"That doesn't matter. Your car's computer is in constant interface with the central server. It does that for traffic control and so it will be ready to supply you with assistance if you turn it on in the middle of a trip."

"We must warn others immediately! It may be too late to save me, but perhaps not too late to save others."

"Don't write yourself off yet," I said.

Again, wild hope flared in his face. "And why?"

"I'll explain what I know about this

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stuff, and we'll see if we can't work something out. I'm a computer programmer, so I get all kinds of publications. Some of them are semi-underground things."

"Yes?"

"Well, about five years ago, there was a drive-by shooting in a bad section of my city. Two young men were killed, the gunman got away, and there were no reliable witnesses. No hope was held out for catching them."

"This pertains to our discussion of the directional computers?" Chantlo inquired with great politeness.

"I swear it does. Just listen. The directional computers had been installed in all cars for less than a year at that time. And somebody got the idea that if you went into the main server, you could get a listing of every car that was on the street at the time of the drive-by shooting. So the police gave the computer the address and the time, and the computer gave them all of the cars that had been there. So then they asked for the speeds of all of the cars listed. The computer told them that most of the cars had been at zero miles per hour, which means they were parked. Two cars had been moving, and they got details on where and how. One was parked but accelerated rapidly out of the area. The police figured that the driver was a witness, and didn't want to get involved. And the second car had driven slowly into the area, slowed almost to a stop right where the shooting had taken place, and then sped away. That had to be the car."

Chantlo was listening with rapt fascination. "Yes, please go on."

"So the police cross-referenced the computer signatures of the two cars into the vehicle registration database. They got names and addresses of the owners. They searched the houses and found the murder weapon. The gunman and his driver were arrested and sent to jail."

"Impressive," Chantlo observed. "But I am surprised that, in America, such surveillance was allowed."

"Well, there was a lot of controversy at the time," I admitted. "It was all over the news that the police had been able to tell where everyone was. But the police were required to get a court order allowing them to access the server. All information from the server had to be printed out into a judge's hands, who destroyed everything that didn't directly pertain to the investigation. And an appeals court could be called upon to examine the court order and agree that it was justified. If it didn't, the evidence was thrown out of court."

Chantlo was nodding. "I see. And this system of safeguards is not in place in Thusbammanna."

"Right. It probably never occurred to the Americans who sold the system that your government would use it for surveillance of political enemies."

Chantlo digested this in silence for a minute. Then he looked at me. "You indicated that this could help me in some way?"

"Maybe. You have to understand: in America, some people just don't like the fact that the government can tell where they are. Most people are satisfied with the judicial safeguards, but some aren't. So there was some inter-

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est in how to disconnect your car's computer. The obvious answer is to smash it, but that's going to be suspicious in court if you're brought in on other charges. So some computer hackers began playing around with reprogramming them, so the computer says you were somewhere where you weren't. I've read some of the articles."

"I begin to see what you are thinking," Chantlo said.

"Don't get too hopeful," I warned him. "The state government eventually put security safeguards into the main server so that it couldn't be hacked into. But the safeguards are very recent—yours may not have them."

"So your intent is to—er—'hack' into the government's computer server?"

"Right. And establish that you weren't where they thought you were."

"Oh!" he said with deep emotion. "Oh, Mrs. Anderson! If you could do that, my family would be grateful forever!"

I grinned excitedly. "Do you have a garage?"

"I can borrow one quickly."

He began giving me directions on how to reach the garage, and my mind kept working at the concept. "You know," I said, "from the first moment at the airport, I wondered why in the world your government would buy this road guidance system, when your country has so many other basic needs."

He scowled. "Many of us wondered the same," he said. "Their stated reasons, that of encouraging tourism, and relieving traffic congestion, lacked conviction. And now we know: it is the basis of their success in crushing the resistance movement."

"But they have so little money!"

"It is a question of priorities, Mrs. Anderson. They prefer to let the people starve. Maintaining power is their only priority. If they discovered a surveillance system that would enable them to crush the resistance, they would produce the money for it in any way necessary."

"But why would America sell it to them?"

"It was a straightforward purchase," he explained. "Thusbammanna had the money, and an American company had a system they no longer needed. If anyone asked, I am sure Thusbammanna would have mentioned tourism and traffic congestion, but I am certain that questions were never raised."

It was dark and dank in the garage, and the chair he found for me was rickety and uncomfortable. Vermin had scuttled out of the way when he turned on the light. And for all we knew, we could be raided by security police at any time. And watching Chantlo, in his agonized hopefulness, put a crushing, almost debilitating weight on me.

We had taken a very roundabout way to get to this garage. Chantlo had had us stop off at several busy intersections, and had me wait while he walked down the street, stopped in at various places, then hurried back. When I had asked what he was doing, he merely said that he was spreading

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the word about the computer monitoring devices through some "message centers."

I set my notebook computer on one of the fenders of my rental car, and looked at the main computer assembly under the hood. This was what worried me. I mean, I had been a hacker almost since before I could talk, but connecting up properly was crucial. My memory of those articles, scanned for pleasure from a computer Bulletin Board System when I was taking a break, was hazy at best.

I took a deep breath. "Let's do it."

"Indeed, yes."

I burrowed into a side pocket of my computer carrying case and pulled out a bag of computer junk. Duane always called it my Techno-Nerd Packet, because it had all kinds of computer accessories that I carried around, figuring I might need them sometime.

The car's computer had a diagnostic port, and I rummaged through my bag, searching for a connector that would fit. I was most worried about that, although I figured I could probably jury-rig something if I had to.

Murphy's Law: it was the second-to-last connector in my bag. But it fit, and we were in business. I booted my computer, and chortled in triumph as the startup diagnostics verified the connection.

My memory of the article stank, but I had confidence in my hacking abilities. In no time, I was in the central computer. I chuckled. "Why even bother looking for the back door, when the front door is wide open?" I commented.

"Pardon?" Chantlo inquired politely.

"Just talking to myself. You know, this software is so obsolete that your government probably didn't even buy it directly from America. You're probably the third users, after some country like Brazil updated their system and sold this to you."

After browsing considerably, I figured that the Thusbammannan police had merged the traffic tracking file and the vehicle identification file, so they could more efficiently know who was where, when. I explained it to Chantlo, presenting proof that my theory on how they followed him was right.

"I'll need your help now, Chantlo," I said.

He came up behind me uncertainly. "Sadly," he said, "my knowledge of computers—"

"It doesn't matter," I interrupted. "You can read Thusbammannan. See if any of these eight-character file names would be an abbreviation for a Thusbammannan word like 'criminals,' or 'resistance,' or anything like that."

He crouched beside me, squinting with intensity. After five minutes, he jabbed a finger at the screen. "There, Mrs. Anderson! That word could possibly be an abbreviation of 'suspects.'"

"Perfect!" I accessed the file swiftly and began scrolling down. Chantlo, reading over my shoulder, inhaled painfully.

"These names! They have identified many resistance leaders, including some who we thought were above suspicion! This is most grievous!"

"I've got an idea for that too," I said.

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"But first let's find you."

Another five minutes yielded his file. "It's not extensive," I told him. "Maybe they tumbled onto you fairly recently."

"Indeed, no, Mrs. Anderson," Chantlo said. "This message at the top notes that I was the driver for your father. I have been under suspicion since then!"

"Look over the rest of them," I instructed. "See what they have on you. Check especially for recent listings. There must be some reason they chose today to swoop in and take your family."

It was several minutes before we figured it out. The entry that was highlighted was the one that noted that Chantlo's car had arrived at an open-air market at the same time that an American subversive force got there by taxi.

Chantlo and I looked at each other for a long time. "You are, of course, the subversive force," Chantlo told me unnecessarily.

"Yeah. Wow."

He sighed. "I had thought that meeting you at the open-air market would have prevented our detection. I parked on the opposite side of the square and took a circuitous route through the crowd."

"You would have been able to shake off a human follower," I guessed, "but you can't fool a computer that way." I thought. "Where should we put you instead? Who would be willing to swear that you were with them? Your mother? Another relative?"

"An excellent idea. My mother lives somewhat near that neighborhood."

It was enormously tedious, going through each line of code and changing every interaction to have Chantlo's car arrive at his mother's house instead of the market, and then having it drive away again. And then I had to explore many other operating files, to make sure I had covered up all of the traces of our tampering. Then I found my file, which had been red-flagged, and altered the file attributes to make them unable to follow me.

I leaned back and took a deep breath as I snapped off my computer. "That's it. We're set."

Chantlo's eyes were shining in the gloom. "I am deeply grateful, Mrs. Anderson," he said with simple and moving gravity.

"I'm glad I could help."

"And now what is your suggestion for freeing my family?"

"Seems simple to me. You go down there to demand their release. When they arrest you, you protest that you were nowhere near the scene in question. They check, to provide proof, and suddenly their whole case falls apart."

He looked at me oddly, and disappointment filled his face. "Forgive me if I insult you, Mrs. Anderson, but you are very American."

I laughed. "My dad says you told him the same thing. Why? What am I overlooking?"

"Thusbammanna does not have the system of justice that you take for granted. Proof is not required in Thusbammanna—merely suspicion. There is no reason to expect them to release me."

I had thought of that. "Yes there is, if we bring someone along."

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Chantlo snorted scornfully. "One of your American lawyers would be among the first to be executed in Thusbammanna."

"Some Americans would pay to watch something like that," I joked. "But I was thinking of a reporter from the Associated Press."

Chantlo looked very impressed. "An excellent suggestion! The government is extremely conscious of its image, especially in America. The underground has had some success in informing the outside world of the brutality here. Foreign aid has been denied or delayed in the past because of objections from human rights organizations."

We left the car in the garage, and walked several blocks to a squalid apartment building. It was reasonably clean, but the structure of the building was deteriorating. Chantlo left me on the sidewalk, where I was the subject of many curious stares. I felt very American; very self-conscious, especially when three different women came up to me and offered me tea. Knowing nothing of their language, I could only smile and shake my head. I found that I was bowing, trying to express appreciation at this offering that I didn't understand.

After several minutes, Chantlo came out again. "It is arranged," he announced. "Our underground network knows many reporters who are sympathetic to the plight of our people. One from the Associated Press will meet me in front of the police station in an hour."

"Chantlo, while I was waiting, several women offered me tea. Why'd they do that?"

Chantlo looked surprised. "You are a stranger; a visitor. It is a gesture of hospitality and welcome. Surely strangers in your neighborhoods are treated in a similar way?"

I laughed, with little humor. "No. In America, when you see a stranger, you call a cop. Your way is much better."

"Do not be hasty in your opinions," Chantlo said darkly. "In Thusbammanna, a policeman is the last person one would wish to call."

We walked back to the garage and set off in my car, since we could now drive anywhere without being tracked. We agreed that I would drop him off at police headquarters, and then go wait at my hotel. "It would not be wise to be seen together," Chantlo said.

As we approached police headquarters, I could see a camera crew setting up. Chantlo saw it and nodded. "This reporter is quite thorough," he said approvingly. "And he has considerable influence in Thusbammanna. He is the chief correspondent, and works closely with the American ambassador whenever trade talks are held, or when military bases are discussed. The police will not dare to simply shut him out."

I dropped him off around the corner, and wished him luck. I hoped I looked reassuring, and I could tell he was trying to be confident.

"I'll see you in just a little while, Chantlo," I croaked through a dry throat.

"In just a little while," Chantlo repeated bravely. Then he walked toward the police station.

I drove to the hotel, and paced

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back and forth across the room for what seemed like hours. It had to work, it just had to! What would I do if it didn't? How could I live with myself if I had screwed up, and ended up costing Chantlo his life? The events of the past several months had destroyed my self-confidence. Who was I to think I could help these people anyway?

Someone knocked on the door, and it scared me to death again. I was beginning to hate that door. But I rushed to open it, and almost ran into the same porter who had showed me my dad's picture.

He was smiling broadly, and in response to my agonized look of inquiry, he gave me a discreet "thumbs up." He handed me a piece of paper. "A message for you, madam." He smiled at me again, and left.

I was sagging against the door frame in relief. I unfolded the paper, and saw that it was an address again. I felt too weak to drive, so I went down and hailed a cab.

The address turned out to be Chantlo's home, not far away. I heard a commotion inside, and when I knocked, I was greeted with an enormous outpouring of noise and celebration.

In the crush of people and emotion and gratitude, Chantlo introduced me to his wife and children and a dozen other relatives and friends. They were all weeping with relief and joy, and it was wonderful and embarrassing at the same time. "You have saved my family," Chantlo called above the general hubbub. "You have saved the resistance movement! You are a great woman! Our gratitude to you will never diminish!"

I was blushing like crazy, and enormously gratified. Marina, whose English was rusty, kept saying "Grateful, grateful," to me, and even Anya favored me with a small smile.

"I'm very glad it worked out," I said over and over. "My best wishes for your family and your country." I felt stilted and formal, but it was still wonderful.

During a lull, I slipped a computer disk out of my pocket. "Does your resistance have any kind of computer experts?" I asked in a low tone.

"They are rare, but they do indeed exist," Chantlo said. "Being unfamiliar with the computer field, I am not certain of their skill level. It may not be equal to yours."

"It doesn't matter. This disk has a record of everything I did to the computer server, and also has instructions on how to hook up and hack in. It also has a few of my favorite viruses that they can plant if they want. Anybody familiar with programming can do the rest. You can plan your best strategy, and do whatever you want to those bastards. You can even blow up their whole database."

He took the disk with deep gratitude. "This is the most valuable disk in Thusbammanna," he said. "I will see to its proper distribution."

After an hour or so, the party started to wind down. I asked how I could get a cab so I could get back to the hotel.

"Allow me to escort you, Mrs. Anderson," Chantlo offered. "Anya will accompany us as well, for she plans to

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visit with relatives who live in that direction."

"Sure," I said, smiling at Marina. "We'll take care of her," I promised flippantly.

The three of us headed out shortly afterwards and walked in happy silence. I was glad I'd come to Thusbammanna. I had helped them out of a tight spot, and I'd gotten my self-confidence back. It worked out very well, just like it did for my dad. Very neat, very tidy.

"I suppose I'll go back home tomorrow," I said finally. "I'm glad I could help you out."

"Your presence was crucial," Chantlo told me. "We are deeply grateful, and you will be welcome in our country at any time."

"Thank you very much," I told him. "And you've helped me too. I got my self-confidence back. I plan to restart my business, thanks to you. It's neat how it all worked out."

"Yes, indeed."

We were walking through a large square, and I noticed a large crowd gathering. Someone was standing up on the far end, testing a megaphone.

"What's going on?" I asked.

Chantlo grinned. "The fruits of your labor, Mrs. Anderson. The word has spread about the government's monitoring of each car's whereabouts. It seems as if a protest demonstration is forming."

"Really! How satisfying!" I stopped and watched for awhile, gloating in my success. A huge crowd had gathered, numbering in the hundreds. Someone got up on the steps of a fountain and started addressing the crowd. I had picked up a few words of the Thusbammannan language, but this was far beyond me. So I just enjoyed the feeling, and watched the crowd as it grew in size and volume. We all felt like celebrating, so we stayed for quite awhile, watching and listening.

Suddenly, Chantlo grasped my arm and pointed. I followed his gaze, and my heart leaped in my throat. "Soldiers!" I hissed.

A contingent of soldiers, fully dressed in riot garb, was assembling at one end of the square. The crowd was disturbed, but too angry to be frightened. "They are too few," Chantlo said. "They must only be attempting to contain the crowd if it becomes unruly."

I felt the tension mount as more soldiers appeared, and the crowd's mood began turning dangerous. It was clear they weren't going to disperse quickly.

I stood in the milling crowd, looking at the soldiers on the other end of the square. *This isn't my fight,* I kept thinking. *This isn't even my country. I have a family that I have a responsibility for. I have no business endangering myself this way.*

I looked around for a way out of the square. *This looks a little too much like Beijing's Tiananmen Square for my taste,* I thought. *I've got to find a way out.* I looked to the left, away from the police, and so I was the first one to see the attack coming.

For the first split second, the words froze in my throat. Then I screamed at the top of my lungs: *"NOOOOO!"*

I threw myself to the street just milliseconds before the machine

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guns began firing.

I felt the rough pavement pressing against my cheek as the guns drowned out all noise except for the screams. Dimly, I saw people throwing themselves to the ground or trying to run. A woman ran in my direction, was hit, and fell nearby in a spray of crimson. Numb with shock, I looked the other way, and saw Anya lying near me, staring with wide eyes. Blood seeped from her arm. I scrambled over to her, and sheltered her head with my arm.

"Lie still, sweetheart," I whispered. I remembered that my dad had called her that, years ago, when he saved her from these soldiers. But I wasn't my dad. I was just me, and I was probably going to die in the next few minutes. I squeezed my eyes shut as the firing continued, and I tried to burrow into the asphalt. Dad couldn't have done anything about this. Nobody could.

Abruptly, the firing stopped, and I risked a peek around. The square was filled with bodies, but I saw many of them moving. Like me, most people had thrown themselves to the ground. I looked around for Chantlo, but couldn't see him.

A deathly silence filled the square, broken only by screams and sobs of wounded people. I heard Anya whimpering softly beneath my arm.

Suddenly, a whistle shrilled, shattering the silence. The police, clad in full riot gear, had formed a line, and now they charged into the crowd, swinging billy clubs.

"Oh, Jesus," I whispered prayerfully. I lifted Anya to her feet, and started pulling her away from the soldiers. "Come on, let's get out of here," I called to her over the rising pandemonium of screaming and yelling and violence.

Limply, Anya tried to walk with me, but was unsteady and slow. The soldiers were charging toward us, clubbing down everyone that moved. "Hurry up, hurry up!" I screamed at her, filled with panic. They were catching up, they were coming, they were right on top of us! A huge soldier came up on Anya's side, his club raised high. *"NOOOO!"* I screamed, "she's just a little girl!" I let her go and charged the man, crazed with fear and rage. *"BASTARDS!"* I piled into him with a football block, hitting him in the stomach with all of my pitiful, meager strength. It took him by surprise, and he missed her as he swung, the club just glancing off her forearm. He looked at me with outrage and surprise, and I didn't even have time to move as he raised his club high. I watched in slow motion as it came down at me and caught me full on the side of my face, and then it felt like my head split wide open. I briefly thought I felt the asphalt on my cheek again, but then I didn't feel anything anymore.

When I regained consciousness, I was still lying on the asphalt. I opened my eyes, and a searing stab of pain made me close them again. I felt something sticky and wet on the side of my face, and when I tried opening my eyes again, I saw that it was a pool of blood. I closed my eyes again, sick with fear and pain. I couldn't believe this had happened to me. I couldn't

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believe this could happen at all.

Breathing hurt. Moving hurt. Existing hurt. I pried my eyes open again, and the first thing I saw was Anya. Her bruised and bloody face lay in quiet repose only a few feet away, and when I tried to cry, I realized that I had been crying for quite some time.

The pain was incredible—I wished I would die so it would stop. But overriding the pain was the urgent need to know if Anya was alive or dead.

Slowly I scrambled over toward her. My head felt ready to burst apart at any moment, but I managed to hold it together. I had to feel for her shoulder because my eyes wouldn't focus consistently, and then I shook her gently.

"Anya," I whispered. "Anya, say something!"

She didn't move, and I tried to see if there was anyone around who could help. On the other end of the square, soldiers were rounding some people up, and I wondered if everyone was going to be shot or jailed. I shook Anya again, more urgently.

"Anya! Anya, talk to me!" I tried to feel for her pulse, but my entire body was throbbing, and I couldn't feel anything else.

A faint moan came from her mouth, and I felt relief cut through the horror, pain and fear. "Come on, honey, we've got to get to a hospital." I staggered to my feet, trying to lift her and fight off the waves of nausea that threatened to drown me. Her eyes fluttered open, and recognition flickered in them. She tried to stand, but staggered into me. I moved toward an alleyway that would get us out of the square, half carrying, half dragging her.

We were almost there when I dimly saw a figure crouching in the shadows. He was holding something to his shoulder, pointing at us. I staggered backwards. "Don't shoot!" I cried.

He straightened up, and I saw that he was holding a news camera. "Sorry, lady, they're shooting at reporters out there. I have to get my shots from cover. Are you American?"

I nodded weakly.

"What happened out there?" he asked.

"It was a peaceful demonstration," I said shakily. I realized he was filming me, and I tried to mop some of the blood and tears from my face. "These people were protesting a brutal government. But the soldiers opened fire with machine guns, and then went through and clubbed anyone who was still moving." I indicated Anya, who had passed out again, and started crying again. "Look what they did! Look what they did to this little girl!"

His camera lens was moving, and I could tell he was getting a standard Close-up of the Crying Lady. After everything else, I was being exploited for ratings points!

"Is there anything that can be done?" he asked in a leading voice.

"Yeah," I snapped, suddenly filled with anger. "You can dump your fucking camera, and help some of the injured people out there!" Without waiting for an answer, I picked up Anya, and staggered away.

The alley went on forever. I didn't know what was on the other side, but I had to get there. On the other side might be someone who wasn't a soldier. On the other side there might be

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a hospital. With pain killer. With morphine. With anything that could help Anya, and stop my pain. Anything. Somewhere. On the other side.

It was bright Sun, but it was foggy. I couldn't see very well through the fog. It was hard to stay on my feet, but I had to keep going. Maybe it would be easier if I went on my knees. Yeah. My knees were better. If I fell over, I wouldn't fall as far. And I could get up again. To get to the other side. Like the chicken in that old joke. Or like the one Tom liked to tell, why did the punk rocker cross the road, he was stapled to the chicken, oh you're a riot, Tommy, I wonder if I'll ever see you again, the last time I saw you I yelled at you and I just wanted to say I love you, you and Alicia and Duane, oh Tommy, help me carry this little girl, she's too heavy for me and I can't do it, I can't do it any more, I have to go just a little bit farther, there's that asphalt against my cheek again, I'm really getting tired of that.

I was on a ladder in a sewer. I was slowly climbing the ladder, because I could see a distant dot of light at the top, where I could get out. Surrounded by darkness, I was beckoned by the light. I climbed and climbed, and some noise came faintly to me from the opening above. I kept climbing, and climbing, and climbing. The circle of light was bigger now, I was getting to it, I was almost there, and then I opened my eyes.

It hurt. It hurt a lot. I gasped in pain, and that hurt too. When my vision cleared, I looked up into Chantlo's eyes.

"Ah, Mrs. Anderson!" he said softly, but with relief. "I am delighted to see that you are with us once again!"

"Wha—"

"Do not speak, Mrs. Anderson. You have been grievously injured, and must lie still. But you are safe now, in a friend's apartment, and you will recover."

"Whe—"

Chantlo restrained me again. "Anya is in similar circumstances. She will not die. I found you in an alleyway, both unconscious. I brought you here with the help of one of your country's newsmen. It is well that you were able to get out of the square, for everyone who remained in it has been detained by the security police, and are likely to be executed. I am filled with wonder that you had the strength to go that distance while carrying Anya, with the injury you have received."

"I'm tough," I muttered thickly, ignoring his restraining gestures. "Got it from my mom."

"I, on the other hand, was merely lucky," he said. I looked blearily at him, and noticed a large bandage on the side of his head. "A bullet grazed my skull, knocking me unconscious. The police left me for dead."

"God," I whispered, and looked away. The horror of the event washed over me in waves.

"I have other news as well," Chantlo said. "A telegram was delivered to your hotel. Our contact at the hotel managed to get it to us."

I took it with shaking fingers and struggled trying to open it. Chantlo did it for me, and I unfolded the flimsy paper. I had to work to focus my

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eyes before I could read it.

"SAW YOU ON CNN. WE ARE SICK WITH WORRY FOR YOU. PLEASE COME HOME IMMEDIATELY. LOVE, DUANE, TOM, ALICIA AND DAD."

"They saw me on CNN," I said wonderingly. "How would they see me on CNN?"

"Surely you remember the news cameraman? The one who helped me get you and Anya to safety? I have not seen the film, but I understand from others that it featured large amounts of blood, and highly colored language."

"I'd better send them an answer," I said.

"Unfortunately, that will not be possible," Chantlo said. "Martial law has been declared, and all communications have been suspended."

"Martial law? Because of the protest?"

"No, because of the hundreds of protests that resulted from the brutality of the crackdown that injured you."

"Hundreds? How could hundreds of protests have gone on?"

Chantlo smiled gently. "You have been here for three days. During that time, the rebellion has spread throughout the country."

I closed my eyes wearily. "Wow. Oh, wow. So the revolution is growing?"

"I fear not, Mrs. Anderson. Most of the army remains loyal to the government. Hundreds have died. These protests were unplanned, and have no leadership. They are ill-timed and doomed to failure. Small pockets of soldiers have defected to the rebel side, but they are foot soldiers based primarily in the country, where the revolution is stronger. Here in the city, where the armored divisions are based, the independence movement is being crushed."

I shook my head miserably. This wasn't how it was supposed to work. The people were supposed to prevail. It's what I'd been raised to believe. I'd seen it happen in the Philippines, Eastern Europe, and Russia. But instead, it was Tiananmen Square all over again. All of the suffering, all of the cruelty ... I realized I was crying again. Chantlo patted my shoulder gently.

"There, there, Mrs. Anderson. While I am extremely disappointed at the failure of the protests, I am yet thankful that I was able to bring you to safety. And we are all grateful that you have saved Anya from death."

"It probably just prolonged the inevitable," I said bitterly.

"Perhaps, or perhaps the success of the revolution is inevitable. If the army had turned on the government, if the government had had foreign pressure to flee, and had been offered a place in exile, it might have happened this time. I believe that many of the soldiers are decent men who are not comfortable with killing so many of their countrymen, but they dare not object. Perhaps next time, Mrs. Anderson. We as a people have learned to live in hope of next time."

"I'm American," I retorted sharply. "I want it now."

He only smiled; a smile filled with sorrow and pain. "Here are some pain killers, Mrs. Anderson. Take one, and rest."

I didn't see Anya until the next day. The pain in my head had subsided

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somewhat, and I was able to walk around. I kept thinking about my family, and the anxiety they must be feeling, but I had no way of leaving, and no way of reassuring them that I was OK. I shut down that line of thought as best I could. I'd go crazy otherwise.

The nurse who had taken care of us gave me permission to walk, and permission to see Anya. Unsteadily, I walked into the next room, and saw her lying on a cot in the gloom.

"Hi, Anya," I whispered. She looked at me with a huge, dark eye. I realized that the other one was bandaged shut. This was the second time in her life that she had been beaten by soldiers. I wondered how many more times it would happen.

"Hello," she whispered.

"How are you feeling?" I wanted to touch her, or hold her, or comfort her, but I didn't know how badly she was hurt.

"The pain is less now," she said brokenly. "The soldiers. . . ."

"Shush," I whispered. "It's OK. You're safe here."

"I remember you carrying me."

"I didn't get far," I said.

"Mother says you saved me." She swallowed with difficulty. "Thank you, Mrs. Anderson."

The sincerity of her voice made me feel warm all over. "You're welcome, sweetheart." I kissed her on the forehead. "Go to sleep, dear."

She smiled, and closed her eyes.

In the other room, I saw Anya's mom sitting and waiting for me. "Hi, Marina," I said in surprise. "I didn't know you were here."

"Chantlo say what happen," she said in her broken English. Tears came to her eyes. "Many thanks to Mrs. Anderson."

"You're quite welcome."

"Your father save her once. You save her once. Andersons great family," she persisted.

I hugged her, and held her while she cried. Gratitude makes me uncomfortable, but it was beautiful nonetheless. I cried with her for awhile. These people deserved better than this.

After awhile, I looked up and saw Chantlo standing in the doorway, smiling at us. Marina and I stopped crying, and he waited until we finished sniffling and drying our eyes.

"Mrs. Anderson, I have some news for you," he said. "Are you familiar with your American embassy?"

"I know we have one, but that's about it," I said soggily.

"It is, of course, here in the capital city," Chantlo said. "And as you are a citizen, you will surely be admitted into the embassy compound. There you will be safe, and will be able to transmit a message to your family as well."

"That would be wonderful!" I exclaimed.

"Indeed. And may I beg that when you return to America, you tell them about us, and the atrocities that you have experienced? You may be the most effective spokesperson for our cause that we have yet found."

"I promise I will," I said. "How do I get to the embassy?"

"Transportation has been shut down by the protests," Chantlo said. "But it is perhaps an hour's walk."

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"Draw me a map," I said.

"It would be better if you were to wait until tomorrow," Chantlo said. "You are not yet recovered."

"I can't wait another minute," I said firmly.

After some discussion, they saw that I wasn't going to change my mind. Chantlo insisted on coming with me, and Marina and Anya declared that if I was going, they were going too. I felt guilty about taking Anya that distance, but she was determined, and it put off saying good-bye for awhile.

We set off after an hour. I felt unsteady, but driven by determination to reduce my family's anxiety as quickly as possible. Anya, being younger, had bounced back more quickly than I had, and seemed more energetic. She refused to wear the bandage that covered half her face, and would only consent to a much smaller one around the area where the billy club had hit her. Marina was completely exasperated, and I smiled in recognition.

As we left, I saw Anya take a bunch of daffodils from a vase in her room. She tried to hide them from me, and I knew she was planning on giving them to me as a farewell bouquet. I pretended not to see.

The streets of Thusbammanna were in shambles. There were almost no unbroken windows to be seen. Broken, smoking barricades dotted the city landscape. People were everywhere, milling around uncertainly, dangerously. Troop trucks filled with soldiers roared around everywhere, looking for trouble, and occasionally I saw a tank, rumbling monstrously down a city street.

After about half an hour, we approached the radio station. We stopped so I could rest, and we gazed at the people inside. It was one of the last structures to be held by protesting citizens, and Chantlo said that it wasn't likely to last much longer. Rough barricades had been thrown up around the gate. It looked terribly feeble: even I, with absolutely no military knowledge, could tell that the tanks I'd seen wouldn't even be slowed down by them.

A crowd had gathered outside the fence, and some of them were singing. Small campfires were burning on the sidewalks. But most of the crowd were spectators, standing in clusters and talking in low tones as they gazed at the locked building inside.

Chantlo looked at the fortifications and shook his head. "So our revolution comes to this," he said bitterly. "I have never seen anything so weak in my life. I hope that the fools inside are speaking quickly over the airwaves—they will not last long when the soldiers and tanks arrive."

I nodded forlornly. It was clear that the uprising had fizzled out; crushed by the superior force and tactics of the Thusbamannan military.

We had paused in front of the radio station to rest. Now I wanted to leave, so I wouldn't see the end. I was about to suggest moving on, when a couple of blocks away, we heard the snarling bellow of tank engines.

"The tanks!" Marina cried.

"They are coming," Chantlo agreed grimly. "And there is nothing we have

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that can stop them."

As he spoke, the tanks turned a corner and roared toward us. With murmurs of apprehension, the crowd got to its feet and made way for them. Some of the campers outside the gates stamped out their fires. A few shouted some slogans, but they could barely be heard over the tank engines.

There were ten tanks in all, and I wondered why they felt that so many were necessary. It was probably because they weren't needed anywhere else any more. And a radio station would be a perfect place to stage a show of force.

The crowd parted in front of the tanks as they advanced in single file toward the gate. Thousands of people were on hand to watch, many with tears in their eyes. Some revolutionary banners were waved, but in a half-hearted fashion. Somehow, we had moved so that we were right in front of the main gate, and the tanks would pass right in front of us. I covered my ears as they approached: the noise of their engines alone was enough for me.

They bellowed forward, enormous and invincible. I reflected with pity on the idealism of the Thusbamannan people who thought they would have something powerful enough to stop those tanks.

The leading tank was approaching, and began accelerating to smash through the barricade. The noise of the engine was deafening even with my ears covered. *This is it,* I thought sadly. *This is where it ends.*

I saw a quick movement beside me, and Anya slipped out of the crowd. Before we knew what was happening, she was standing alone in front of the gate. Marina gave a cry of terror and tried to dart out to Anya, but Chantlo held her back.

The tank was accelerating loudly, and the driver was as taken by surprise as the crowd. It jerked sharply—the engine sputtered—and it screeched to a halt only six feet from the girl.

There was a dead silence for a moment, broken only by Marina's sobs.

The tank gunned its engine: a challenging bellow that echoed and reechoed off of the surrounding buildings.

Anya looked up at the tank without a single trace of fear. She held the little bouquet of daffodils just below her throat, and she gazed steadily at the tank, her scarred face looking slightly distorted, but totally devoid of fear.

The tank lurched forward, and jerked to a stop only two feet from her. I stood rooted to the pavement. *Oh God, oh God, oh God,* I thought feverishly as I watched, transfixed in terror. *Oh God, the poor little girl!*

The tank activated a siren, almost rupturing my eardrums. I bent over halfway, trying to cover my ears, trying to shut out the noise.

Anya didn't even flinch. She just looked calmly up at the tank as it towered above her.

The tank jerked into reverse, and backed up ten feet or so. Then its two machine gun turrets ratcheted downward and to the center, both homing in on the girl.

Anya lifted her bouquet of daffodils,

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as if offering them to the machine guns.

There was a deathly silence.

Marina tore herself from Chantlo's grasp. She rushed to her daughter, and threw her arms around her from the side. Then, instead of trying to drag her away, she turned her head and looked up at the tank, tears flowing down her face.

"Will you shoot your children?" she cried. "Will you shoot your mothers?"

The tank loomed ominously above them. Then, finally, the machine guns swiveled away and pointed at the sky.

The cheer from the crowd began more as a gasp, but grew in size and volume into a roar. It crescendoed as the door on the top of the tank opened, and an army officer climbed out. He jumped down from the tank, walked into the crowd, and said something I couldn't hear. The crowd near him cheered even louder, and he took a revolutionary banner from someone. He walked back to the tank, and draped it across the turret, and the crowd screamed and cheered, and I thought I would yell my throat out.

He walked up to Anya and Marina. Marina was still sobbing, now with relief, but Anya remained cool and collected. She smiled at the officer, and offered him a flower from her bouquet. When he took it, she reached up and kissed him on the cheek.

The officer leaped back up onto his tank, and shouted something down inside. The tank turned around and took the lead again as it headed back into the city. The other tanks followed, with people throwing revolutionary banners up to the crews, who draped them over the turrets. The crowd, thousands strong, accompanied the tanks, singing and cheering as they went. I watched them go, and it seemed like every side street disgorged a hundred more people who joined the crowd.

Anya stood still, with an exalted glow on her face. We surrounded her, all quietly crying, hugging and kissing her. We didn't move until we were disturbed by a rattle of small-arms fire in the distance. It was quickly answered by the heavier sound of a tank's machine gun.

Chantlo disengaged himself from the little group. "This city is yet a dangerous place," he said. "We must find the American embassy quickly."

We hurried through the city streets, sometimes struggling through crowds of people, sometimes finding the area eerily deserted. Troop trucks and tanks passed us occasionally, many with revolutionary banners draped across them. We heard sustained gunfire in many areas, although we managed to avoid being in the vicinity.

Long after I was completely exhausted, we reached the American embassy gates. There was a contingent of Marines inside the walls, armed and on alert. I hurried up to the guard.

"I'm an American," I said quickly. "These are my friends. I need to get inside."

He looked at me with startled recognition. "You're the lady from CNN! The one that caused all the trouble!"

"What?" I asked, startled.

"The ambassador wants to talk to

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you! Get inside, quick!"

"Whattaya mean, 'caused all the trouble'?!"

"Come on." He grabbed my hand, and dragged me after him. Another Marine stepped forward to take his place at the gate, allowing Chantlo, Marina and Anya to follow me uncertainly.

The American embassy in Thusbammanna wasn't all that big, but I was so tired that it seemed like a long trek before we were allowed to collapse into cushy chairs in the ambassador's outer lobby. Seconds later, I was called into the ambassador's office. I paused before going in, looking at the armed Marine hovering menacingly over my compatriots.

"You saw me on CNN?" I asked him.

He nodded.

I indicated Anya. "This is the girl I was carrying. The woman next to her is her mother. And this man," I indicated Chantlo, "is the man who found us and saved our lives. Be nice to them."

He grinned. "Yes, ma'am."

I went inside, and was presented to the American ambassador. She looked like she hadn't slept for awhile, but her gaze was piercing as she looked at me. "So," she said, "you're the woman who started a revolution."

"What? How?" How could she have known about my hacking into the Thusbammannan computer server?

"That clip of you on CNN really stirred things up in the States," she informed me. "It galvanized public support, and got the government involved. What was it you said: 'you can drop the fucking camera and help the wounded people'? Something like that?"

"I really don't remember," I said truthfully. "I was in bad shape."

"So it appeared. I have to say that I'm surprised to see you still alive, considering how bad you looked on the news."

"That's what I'm here about," I said urgently. "My family sent a telegram. They're terribly worried about me. I need to contact them and tell them I'm OK."

"That can be arranged," she said. "But more to the point, you're going to be leaving for the States in a few hours."

"Really?"

"Absolutely. We want you out of this country as soon as possible. You have, unwittingly, sparked something chaotic and violent in Thusbammanna. It serves neither your interests, nor the interests of the United States, to keep you here. You'll be driven to the US airbase and shown onto a transport plane in a few hours."

"Thanks," I said gratefully, "but if I can just contact my family, I don't need to leave right away. I'd like to see this thing through."

"You don't understand, Mrs. Anderson. This is an order. I'll have some Marines handcuff you in the plane if necessary."

"Wow." I digested this for a moment. "You folks don't screw around, do you?"

"Neither do you, apparently. Our reports now indicate that half of the Thusbammannan military has defected to the rebels, with more divisions expected to follow suit. The members of Thusbammanna's government in

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exile have left Washington, D.C., bound for here. And the country's dictator is in the final stages of negotiation with Washington, preparing to flee the country to the United States."

"No!" I gasped in delight.

"Yes. I don't know how you managed to get involved in this, but—"

I wasn't listening. I bolted out of my chair, and sprinted for the door. "Chantlo!" I yelled as I yanked it open. I burst into the lobby, almost falling down in my haste. "Half the military has rebelled!" I screamed at them. "Your dictator is leaving the country! Your government in exile is flying here!"

They stared at me in shock. Then, slowly, quietly, Marina started to weep. Anya glowed. And a slow smile spread over Chantlo's face until I thought it would split his head apart.

"This is the happiest day of my life," Chantlo said quietly. "We are deeply grateful, Mrs. Anderson, for your help in our endeavor. Had you not discovered the government's surveillance plot, had you not hacked into their central computer, had you not saved ..." he trailed off as I quickly gestured him to silence. I turned to look at the ambassador as she stood in the doorway, listening.

"You discovered a surveillance plot?" she repeated. "Hacked into their central computer?" She shook her head, but her look seemed genuinely admiring. "We are definitely getting you out of this country!"

I wished that Chantlo could have driven me to the airport, but he wasn't allowed. Instead, I was sandwiched between two extremely large but friendly Marines. The ambassador had given them their orders right in front of me: "Drive this woman to the airbase, and see to it that she boards the next transport plane to the US. Stay there and watch until it's airborne. Then come back and report to me when she's left Thusbammannan airspace."

My good-bye to Chantlo, Anya and Marina had been tearful and affectionate. Chantlo and Marina both hugged me. Anya presented me with the bouquet of daffodils that had already been through so much. Their stems had been squeezed together into a pulp. I briefly imagined the terror that had exerted so much pressure on them, and gave Anya a long hug. "You're a remarkable girl," I told her. "You have a lot to offer your new country."

She was embarrassed. "Just ordinary," she answered, blushing.

During the drive to the airbase I reflected on her answer, and on my return to the States. Coming to Thusbammanna had changed my outlook on everything that had happened to me. After surviving a bloody massacre in a Thusbammannan square, a court battle to clear my name just didn't seem very daunting. If I could endure having my head bashed in to save someone else's child, I could endure even worse, to save my own child. And if a sullen, angry teenager like Anya could flower into such greatness, maybe there was still hope for my son Tommy.

The thing I had learned from Thusbammanna was to never give up hope—to never stop fighting. And

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when fighting with Tommy, I'd remember that if a division of tanks couldn't win the battle, then maybe a bouquet of daffodils would.

I boarded the plane, ready for the fight ahead of me. ■

Author's Note: *This story was inspired by Stan Schmidt's May, 1993 editorial, "Driving the Future," and is a sequel to "The Alicia Conspiracy," which appeared in the March, 1993* Analog.

IN TIMES TO COME

We think our August issue is a fine piece of entertainment but you can also think of it as a puzzle, an exercise in looking for hidden relationships. Our two novelettes are quite different yet have at least one thing in common besides both being novelettes. The same can be said of the short stories.

Hayford Peirce's "The Ore-Ball Express" is the latest entry in his "Ethical Stockbroker" series, wherein extreme measures are needed to make good on a business promise. If standard services won't do, sometimes you have to improvise. . . . Jean Lamb's "Galley Slave" means exactly what the title says but probably not the way you'd expect. It's also something a bit unusual for *Analog*: a story by one author set (with permission) in a world created by another. In this case, it's an incident in Larry Niven's man-kzin wars—or, in this case, *woman*-kzin.

Spider Robinson's "Orphans of Eden" is not in any way a Callahan story, but it does pose a real interesting and haunting problem. Nor does Pete D. Manison's "No Blood on My Hands" belong to any series as far as I know; but it is another good illustration of the unique realms Manison's mind finds to explore.

G. Harry Stine provides the fact article, on the less obvious lessons we can learn from technological history. And last, but by no means least, we have Part 2 of Robert J. Sawyer's mind-stretching novel *Starplex*.

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THE REFERENCE LIBRARY Tom Easton

The Parafaith War, L. E. Modesitt, Jr., TOR, $23.95, 383 pp. (ISBN: 0-312-85904-X).
The Ganymede Club, Charles Sheffield, TOR, $23.95, 352 pp. (ISBN: 0-312-85662-8).
Ancient Shores, Jack McDevitt, Harper Collins, $22.00. (ISBN: 0061052078).
An Exaltation of Larks, Robert Reed, TOR, $21.95, 251 pp. (ISBN: 0-312-85888-4).
One for the Morning Glory, John Barnes, TOR, $22.95, 317 pp. (ISBN:0-312-86106-0).
Cradle of Splendor, Patricia Anthony, Ace, $22.95, 293 pp. (ISBN:0-441-00301-X).
North Wind, Gwyneth Jones, TOR, $21.95, 287 pp. (ISBN: 0-312-85926-0).

I started doing "The Reference Library" several years before I bought my first computer. Once I had a computer, I was able to keep past columns in electronic form, which made it easy to search for previous mentions of authors, books, themes, and the like. However, the early columns were inaccessible. I wasn't about to retype them all!

But technology changes. Scanners are invented, and text recognition software that lets one turn a page of print into an electronic word-processing file. And early in 1995, I upgraded my computer, bought a scanner, and started putting those old columns onto my hard drive.

Now, OCR software is not perfect, especially not when the pages have yellowed and the type is small and marred by too much or too little ink and occasional flecks of dirt. So one who scans must also proofread. In the process of performing that odious chore, I found it quite impressive how many current novels are powerful echoes of others just 10 to 15 years old, not to mention even older. This is not to make any suggestion of plagiarism, but of influence, yes, and perhaps it is only that writers tell stories of the sort they enjoyed when they were in their teens, when their ideas of the proper order of things were being shaped. Perhaps it is also a sign—no surprise!—of how hard it is to come up with a wholly new story.

One of these echoes is **The Parafaith War**, by L. E. Modesitt, Jr. This tale involves an attempt to defeat a religious tyranny, and in some re-

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spects it resembles Heinlein's old "If This Goes On. . . ." In this case, however, the echo is really quite mild. Modesitt's point is more subtle.

Modesitt has written a number of novels about a distant future culture that recognizes that the only real hope of utopia lies in respecting the ecological limits of the natural world. In the past, he has used the term "Ecolitan" in connection with this culture. In *The Parafaith War,* it is "Eco-topian," the time is long after Earth's Great Die-Off, and the foe is not an Empire of power-freaks, but a culture based on some of the most intolerant and shortsighted features of Christianity and Islam (which does not mean, Modesitt stresses, that within that culture people are not nice to each other).

The situation is war. The Eco-topians are engaged in terraforming planets such as Mara, where Trystin Desoll, a lieutenant whose nervous system has been boosted with implants, operates a guard station on the edge of the altered territory. His job is to ward off the attacks of the Revenants, or Revs, fanatics who define all nonbelievers as vermin to be exterminated and refuse to accept the truth that unlimited reproduction is a dumb idea. It is obvious to Desoll that the Revs are by no means stupid, for their military technology is very competent, and the Eco-topians are hard-pressed indeed.

This conclusion is only strengthened as Desoll's competence moves him up the military hierarchy, through pilot training to starship pilot to intelligence and an assignment that will send him to a Rev world with a mission of assassination. There is plenty of action on the ground and in space, but that is hardly the real story, for a third player on the stage is the aliens, the Fahrkans, who make periodic appearances to prod Desoll on whether he is a thief, or a liar, or. . . .

As a literary hero, Desoll of course must do something decisive, preferably something that ends or at least diminishes the war. I won't tell you what that is, or how he does it, partly not to spoil your enjoyment and partly because I do find his victory a bit too easy. I would rather stress the Fahrkans's role, which has much more to do with Modesitt's point: they are trying to make Desoll think about the human tendency to put allegiance in absolutes; Modesitt is saying that many of the tragedies of history that we tend to blame on allegiance to religion or ideology actually have a broader, more fundamental base, the unwillingness to question, the refusal to consider other points of view.

He is, of course, quite right. Sadly, this unwillingness, this refusal, is a very difficult thing to get past, which is why I found Desoll's victory too easy. I am not more critical because Modesitt does provide hints that the victory was not Desoll's alone; there were other factors helping him out, some of them personal, some of them social. You'll see what I mean when you read it.

Charles Sheffield's **The Ganymede Club** is set in the same future as his *Cold as Ice* (reviewed here in the No-

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vember 1992 column), just after a war between the Belt and the Inner Worlds has rendered Earth's northern hemisphere uninhabitable (killing billions), wiped out half of Mars's population of 17 million, and virtually destroyed the Belt. What's left of civilization is centered among the moons of Jupiter, particularly within a well-burrowed Ganymede.

Sheffield begins this tale before the war. In 2032, a crew of explorers find strange contamination, death, and revival on a moon of Saturn. On Mars, 2063, Julius Szabo has put his prior identity of Danny Clay, master gambler, behind him and disguised himself as a retired actuary; to him comes a woman who wishes to know what her life expectancy would be if she could die only in an accident. Shortly after her visit, she is dead and he is falling through near-vacuum toward a hard, hard roof and praying that the arrangements he has made for such an eventuality will actually work out. At Ganymede, 2066, a journalist interviews the heirs of that Saturn expedition, Saturn explorers themselves, and is assassinated in the interests of secrecy. On Earth, 2067, their parents send Lola and Spook Belman to the Belt just as war erupts.

And a few years later, Spook emerges as a young genius who can pose puzzles to challenge the mind of the teenaged recluse Rustum (Bat) Battachariya, who is already showing clear signs that he is the new incarnation of Mycroft Holmes and Nero Wolfe we met later in his life in *Cold as Ice*. Lola has become a haldane, a sort of psychiatrist who uses computers and drugs to heal the mind; her latest patient is a man who has blackouts where he dreams of falling through near-vacuum toward a roof. Spook and Bat are assisting her in unraveling the puzzle. And the Saturn expedition heirs are setting their assassin to checking Lola out.

The rest is detail. The pattern is clear—paranoid immortals, clever detection, hairbreadth escapes from peril, final resolution. In fact the pattern is so clear that I suspect Sheffield really gives out too many clues in the early pages, at least for the experienced reader.

The Ganymede Club is thus best suited for younger readers, in the spirit of the old Heinlein juveniles. Like them, it does not talk down. Unlike them, however, it does contain a bit of sex, just enough to be real; it would be a shame if that is also enough to make some parents and librarians shy away, for Sheffield still writes the classic stuff—albeit built on a more modern knowledge base, using more modern technologies, and recognizing that mores have changed a bit since the 1940s and 1950s.

Does Jack McDevitt believe in sequels? If he did, you'd think, he would follow last year's *Engines of God* with something to explain the mysterious force that attacks signs of civilization throughout the Galaxy. But his latest—a nice fast read, very intriguing, quite absorbing—is something else entirely.

Ancient Shores is set in North Dakota, not far from the Canadian border. Farmer Tom Lasker finds a

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piece of metal jutting out of his wheat field; digging, he finds an entire yacht, complete with sails, sleek and quite intact except for a broken rudder. And there are no clues that anyone buried it within recent memory.

Now that's a real head-scratcher. It's even tabloid material, especially once McDevitt has a character take a sample of sail cloth and have it tested. The results come back: the boat is made of element number 161, right off the far end of the periodic table. It's chemically inert, so it doesn't decay and it doesn't weather. It lasts forever, or near enough. And the boat really has to have been there ever since the region was covered by Lake Agassiz, in Ice Age times.

This is enough to get scientists interested and to panic the stock market (a great many businesses are based on replacing materials that wear out). But then McDevitt's characters start hunting for the boat's one-time dock; they discover it on a local Sioux reservation and find in it still-working portals to the stars.

It's hard to review this one without giving away a good deal. So I won't tell you what they find beyond the portals, or whether the other side is occupied, or whether anything comes through to threaten, frighten, or just astonish us here at home. On the other hand, I do feel it necessary to say that McDevitt's story is not one of adventure beyond the portals, but one of social impact here at home. The panic initiated by ever-lasting materials is nothing compared to what ensues. Business interests bid high for possession of the "Roundhouse." Other nations use the UN to pressure the US into sharing the wonders it is finding. The US government itself is debating taking over the site—Indians be damned—and destroying it in the name of stability. Pressure builds as the characters dig and probe and discover and a thoroughly mind-blowing *promise* becomes clear. But that promise is really only clear to those who are comfortable with science and technology, whether new or old (Tom Lasker and his friend Max, for instance, fly antique airplanes). Politicians, religious nuts, and other crazies are scared stiff.

Is it realistic to portray a government that would seize such a discovery? Probably. Is it realistic to suppose that government would then destroy it? Probably not, though I do think government might keep it under very tight wraps for a long time. Is the story's final confrontation believable? I had trouble swallowing it, though it was a very entertaining scene (and it is foreshadowed on the book's acknowledgments page, where McDevitt expresses "special appreciation to those who graciously allowed their fictional alter egos to be flown into a desperate situation during the closing chapters").

Is it worth your money and time? I think it is, for my objections are minor. Indeed, I hope McDevitt does believe in sequels after all, for this one could permit several.[1]

Robert Reed's *Beyond the Veil of Stars* (reviewed here in the December 1994 column) gave us a heavy dose of "Things are not what they seem"—

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Earth's Universe is but a bubble in a cosmic foam, and the barriers between bubbles can be breached by beings, although they must assume the form of local sentients; that is, your best friend, your wife, your husband, anyone at all, may actually be an alien in disguise.

His latest, **An Exaltation of Larks**, gives us another dose. The scene is a small college, where the campus newspaper editor, Jesse, and his best writer, Jill, are about to blow the lid off the college president's propensity for embezzlement. Now, Jesse is a dedicated womanizer, so when fellow-student Sully puts the make on him, he readily accepts his good fortune. But then the biology lab is trashed and the oldest of its turtles disappears. Radio, TV, and phone fall silent. A mysterious Indian shows up and declares himself a turtle from the end of time, here to convert a few vertebrates into immortals, store everyone else, and destroy the world. When the immortals reach the end of time, they will jump back again, but fifteen months earlier, and after enough iterations of this they will reach the moment of creation and redesign the Universe so time does not end. And oh, yes, he says, there's an enemy among us, out to spoil our effort. Keep your eyes open, and call me if you spot him. Or her. It could be anyone—Sully, Jill, even you.

Who is it? Reed will tell you, eventually, but you must remember that in his hands, things are never what they seem. He's a master of misdirection—at least, I think so, it seems so, but. . . .

Larks is not really a very complicated story. In fact, without so much of the is he/isn't he fum-fawing, of Jesse's constant sexual activity (mental and physical), it might have been no more than a novelette or novella. But a novel it is, and it's a good, if confusing, read. Have fun—or something that seems like fun, anyway.

Speaking of fun, John Barnes must have had a lot of it writing **One for the Morning Glory.** It's a highly entertaining medievaloid fantasy, beginning when the young prince snaffles a glass of the Wine of the Gods, of which it has long been said that "a child who tastes the Wine of the Gods too early is only half a person afterwards." In Prince Amatus's case, the half remaining is his right half, the left half having vanished (though the Prince hardly seems to notice). The responsible parties—the palace wizard and witch, the Captain of the Guard, and the Prince's Personal Maid—are all deftly executed. Their positions are advertised. But no applicants seem suitable until there appears a strange and wondrous quartet.

The tale's mode is that of a fairy tale, and Barnes knows it. Indeed, he pokes fun at it, saying from time to time that in a tale of this sort, certain things—which tend to be quite standard clichés of fantasy—just have to happen. He also pokes malapropish fun at modern fantasy's overuse of outré vocabulary by using a great

1. When I talked with him a few days after writing those words, he said he had no plans for sequels and his publisher is not pushing for sequels. On the other hand, he does want to revisit the characters of *Engines of God.*

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many words that sound fine as long as the reader does not consult a dictionary. For instances, "palanquin" is used for a musical instrument and "simile" is a food; there is a character named "Pell Grant."

Many writers might hang their jokes on a thin excuse for a plot and leave it at that. But if one were to take the japery out of Barnes's tale, what would remain would be a relatively normal fantasy novel. With the aid of that strange quartet, Amatus grows up, passing through a period of rakery to a maturity that bodes well for the Kingdom. There are adventures. There are friends, one of whom is a princess in disguise, last survivor of the royal family of a neighboring kingdom now under the heel of a foul usurper, Waldo. There are hints of war, and at last Waldo's forces pour through the mountains, a horde of undead and goblins and other monstrosities (but where's Waldo?). Disaster looms—indeed, disaster pours over Kingdom and palace and king, and Prince Amatus escapes by the proverbial skin of his teeth.

This being a fairy tale, of course, the Prince must triumph in the end, marry the princess, and live happily ever after. So of course he does. And if there really is rather a lot of standard furniture along the way, at least Barnes knows it too, and his grand good-humored attitude makes that acceptable even to the jaundiced.

Patricia Anthony's **Cradle of Splendor** is a very strange item that I do not think will appeal to *Analog* readers. At its start, it sounds like SF, for the scene is Brazil, where Ana Maria Bonfim is the dictator who knocked the economy into shape, gave women proper human rights, and established Brazil as a technological powerhouse. A crowd is gathered to watch a rocket launch that will put a satellite into orbit. The rocket looks too puny, though, and when its flame sputters out, there is a great gasp of dismay, some of it heartfelt, some of it very satisfied. But then the rocket—flameless!—recovers from its falter and soars into space. The Brazilians obviously have antigravity.

Where did they get it? Now the tale begins to look more like fantasy. Anthony introduces an array of characters—a drunken secret police chief, a flock of spies from Japan and the US, a CIA agent who is a NASA engineer with a thing for UFOs, an artist who has long been a Bonfim friend as well as a conduit for CIA money—so quirky that when she shows us Freitas, a psychic healer, we aren't surprised a bit. But then she says Freitas is the source of all the technological marvels; he has some sort of link to an alternate universe into which he feeds the local "Disappeared" and he generates UFOs from his own body. All very mystical and magic-wandish, and quite in keeping with the spirit of Brazil.

What's the plot? When the Americans see that rocket rising on antigravity, their noses are badly bent. They immediately decide that Brazil is a threat to world order (certainly to US dominance), and with the backing of the UN, they threaten invasion unless Brazil admits inspectors to look

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for military threats. Brazil refuses, and now the characters begin to rush about, looking for a way out of the country, or for a way to protect themselves from plots by fellow spies, or just for another bottle.

The tale thus becomes a character novel, but as such I did not find it satisfying. Part of the problem is that not one of the characters is likable. All are nasty sorts, ugly spirits, real enough of course—Anthony has undeniable skill at portraiture—but not folks you would knowingly invite into your home.

Perhaps this is a part of Anthony's point, for many of the characters are foreigners—those American spies—and South America seems to view Americans as materialistic, spirit-blind, greedy exploiters. Indeed, since even the Brazilians are foreigners and descendants of foreigners (the native Indians do not figure here), and since Anthony's Brazilians may be victims but are no more likable than the Americans, she may be extending that judgment very broadly.

If we look once more at the source of the antigravity (Freitas, the Door, the other universe) and its price (the souls and bodies of the Disappeared), there is also a stern judgment on science, technology, and even rationality. This is a book that may appeal very strongly to the technophobic and the anti-rational, to New-Agers and other fans of claptrap.

North Wind is the sequel to Gwyneth Jones's award-winning *White Queen*. The noseless alien Aleutians have come to Earth with a technology of living "devices" derived from their own bodies. They also seem to have a kind of immortality; individuals reincarnate, complete with memories of past lives, friendships, loves, and loyalties. Or do they? Their religion is centered on leaving behind extensive records of one's life, character, and so on, all on edited film. Those memories of past lives seem to be constructed by watching one's predecessor's records. Perhaps what we have here is really nothing more than something we see whenever a human grows obsessive about some hero and collects so many details about the hero's life that they can—and sometimes do—pass as that hero (just think of Elvis, folks). That is, no real reincarnation, merely pretense that pervades an entire culture. Quite inhuman (unless one thinks of. . . .).

Jones does not question her aliens' immortality explicitly, though she does hint, in part by holding up for our bemusement those humans who have gone gaga for the looties, cut off their noses, changed their diet and other personal habits, and flipped for film. One such person, known as Sidney Carton, is a translator and guide in an Aleutian enclave when human fanatics attack. He saves just one alien from the massacre, dubs him/her Bella, and hies off across the countryside on a tour that shows the reader a pervasive chaos spun from gender war and an alien-disrupted world. In due time, Bella decides Sid's motives are less than pure and flees from his grasp.

And, of course, those motives are indeed tainted. In the previous book, a pair of human heroes attacked the

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Aleutian spaceship using an "instantaneous travel" device. That device is now lost, several factions would love to find it again, and Bella may be the reincarnation, the clone, or the child of one of those heroes. She may, that is, be a crucial key.

In due time, Jones tells the reader all, but I found the most interesting aspect of the book the Aleutian culture (or what I read into it) which treats immortality—whether it is really real or not—as if it is real, and since individuals believe their memories of past lives are real, they might as well be real, even if they have been constructed from obsessive watching of film. The plot, the story, has its moments, but feels often arbitrary, artificial, forced. Jones's real aim may well have been to consider the function of cultural consensus. Which, come to think of it, often seems a bit arbitrary itself.

Get it? ■

(Biolog continued from page 109)
renderings with particularly-close reference to the text. Jim goes to SF conventions, meeting fans and writers; he finds liking SF essential to SF art. He reads each story while making notes. He finds that some artists seem proud of never even reading SF, they save time by asking for a specific brief by the art director. One result of his love for SF has been two Hugo Awards given at the 1985 and 1995 world SF cons held in the UK, along with some ten Best Artist awards at the British national cons.

Media is primarily acrylics, sometimes overlain with transparent inks. He would prefer oils, time permitting, and plans eventually to return to them. Finished work goes on gesso over hardboard. Most pigment is applied with a simple, double-acting airbrush, but brush, fingertips and anything appropriate may be used. Over a rough underpainting is a built-up surface with a lot of glazing for exotic color effects, finished with a satin matte varnish. Computer renderings would lack the final, hand-crafted original appearance desirable for a unique art object and something tangible that can be sold in a gallery. More pen-and-ink interior commissions would be welcome, such as those he did for a collection of Frank Herbert short stories. He painted 29 original color illustrations for Harry Harrison's book *Planet Story*. A collection of Jim's work appeared as a 1985 book *Lightship*.

Jim feels SF not only makes us think about the future but also gives its look to everything in today's world, including VCR's and car dashboards. Essentially a literary form, SF now has an allied visual analog appearing in magazines and on TV screens. An SF illustrator has to imagine the unimaginable and expand everyone's vision of what reality could be. ■

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(Brass Tacks continued from p. 215)

Dear Dr. Schmidt:

As a scientist I started to read your editorial when I discovered that I wasn't included in the subject manner. (I finished reading it anyway even though I am male.) You refer to the (female) scientist A giving instructions to the other scientist on how to repeat her work. (Are B and C also female?) Because of way the English language is structured, the pronoun "she" refers only to female sex while "he" can refer to either sex. Because of the respect that I have for for you and your ability to handle the English language, I am sure that you wouldn't have purposely tried to reduce the defining qualities of the pronouns of our beautiful language, thus reducing in a small way our ability to communicate well. I therefore had to conclude that scientist A was indeed female (i.e. you were not being PC in the use of "she") and that the editorial did not refer to me. Does that imply that only female scientists can do repeatable work? (That would explain some of the data I have seen presented at national technical meetings in which a male investigator develops conclusions based upon the comparison of sets of data with an R-squared of 0.02. This would be expected as, being male, his data are not supposed to be repeatable if I understand the implications of your use of pronouns.) When my work as a male scientist is repeatable is that evidence of my female side coming through?

I have been reading *Astounding/Analog* since about 1955 when I was in graduate school. Having been a fan of John Campbell, I wish to say that I enjoy your editorials very much—keep up the good work. But let's try not to degrade the language.

ROBERT L. DUNNING

A chemist too old to be PC.

Spokane, WA

If you read my June 1989 editorial, "Tools of the Trade," you'll see that I agree with you about the annoying error of those who insist that he *always implies* male *even when it is being used in its long-established generic senses and that* she *can't be (unless and until general usage changes as some people want it to). But in the case you cite, it* wasn't *being used in quite that way. I was giving a hypothetical* example, *in which "Scientist A" happened to be female. Nothing was said or implied about the sex of B or C, and* certainly and emphatically *not about any general ability or inability of males or females to do repeatable work.*

By all means, let's try not to degrade the language by reading sexism into places where none was meant—but let's try to avoid the opposite extreme, too!

Dear Editor:

Before the flame thrower crowd comes in, this reader would like to send three cheers to *Analog* for running Donald F. Robertson's excellent science fact piece "Reach Out and Touch the Stars," (Mid-December 1995). Mr. Robertson's observations on both space development and, more important, of the mind-set of those who are supposed to be pushing space development, are right on the mark.

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Having had a chance to observe up close the attitudes and rhetoric of what passes for the "pro-space movement, I often wondered why nobody in these various groups could see the obvious facts that Mr. Robertson expresses so well. There have been too many cases of overly-high expectations, and there really *are not* that many things to do in space right now that any group of big-money investors is going to buy into as potentially profitable. (Even telecommunications plans can have problems, as witnessed by both Iridium and Globestar pulling bond offering after they found that investors wanted more for their cash than either company was willing to pay.) To hear many of the more popular spokespeople from these groups describe things, you would either think that there is A Deep And Dark Conspiracy to keep humanity penned up on the Earth, or that Someone Isn't Doing Their Job/Believing Faithfully In the Cause.

PPPPPHHHHTTTT!

If the leadership of these groups would wake up and realize what Mr. Robertson is saying is true, that space development isn't going to come into being overnight, some actual progress might be made on the road to making the dream of a space-based civilization a reality. If, on the other hand, they persist in maintaining what this writer can only describe as the Spoiled Brat attitude towards space development ("If what you want doesn't appear as soon as you scream for it, stamp your feet and scream louder"), then progress is likely to range from slow to nil.

Again, bravo for your courage. I now leave you to the (doubtful) mercies of those who have had their oxen well and gored. . . .

ANDREW REYNOLDS
via the Internet

The author replies. . . .
Dear Andy:

For what it's worth, I think there is one other near-term hope that I did not have space to cover. That is the Space Station, hated as it is by many space advocates.

Once the Station is built, if it ever actually is, all of a sudden we have a market that requires n thousand kilograms of supplies in Low Earth Orbit. This bulk cargo *must* be delivered, year in and year out. Nobody outside of NASA seriously believes the Space Shuttle is capable of fulfilling this requirement. Thus, we may soon have a market that is both safe enough and large enough to provide a real incentive for commercial launch suppliers to find ways to lower costs. And, indeed, we already see the world's commercial launch companies squabbling over who gets to supply this market.

We shall see. . . .

Again, thanks for responding to my article.

DONALD F. ROBERTSON

Dear Editor:

I'm not too sure human beings were designed to live on the savannah. I know, that's been touted as absolute truth since the '70s but our closest cousins, the bonobos or pygmy chimps live in much wetter areas, and in many ways we seem to be

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designed for a coastal existence. The evidence that puts it over the tops for me is that, given the choice we will pay far more to live on the coast than on grasslands, all other things being equal. And if I had $100,000 to put into public recreation under a mandate to bring in the most customers I could, I wouldn't put in miles and miles of lawn—I'd put in a swimming pool.

This is important because we were explorers from the beginning. In such an environment we had to be. We were also more at home in two different media (air and water) than anyone but true amphibians and marine mammals. I'm not sure exploring space would even occur to grassland animals as quickly as to coastline ones.

Other than that, nice article. It's just that SF has run so far ahead of reality that we're all getting very frustrated. The worst of it is the fear that if we don't get into space soon and use the resources soon, we'll have missed our chance—like the Easter Islanders finding they had no more canoe-sized trees left.

PATRICIA (PAT) MATHEWS
Email: mathews@unm.edu

The author replies. . . .

That could all be true (though early fossils seem to be far from the coast). There's probably no real way to know. Even if humans are coastal animals, it still doesn't change the fact that we are trying to explore the most alien environment we have ever tackled, and we're disappointed that it's taking longer than thirty years.

As to your last point, I think the end of the cold war has bought us a lot of time. There are many disasters in our immediate future—environmental and social—but none are likely to destroy us completely, like an all-out nuclear war would have. We don't have forever, but we do have many years, I think.

DONALD F. ROBERTSON

Dear *Analog:*

As a new subscriber I must admit to being impressed with the January 1996 issue. I made the *right* blind choice when picking *Analog* last fall. My comment is about the contrasting population articles. I don't think they were terribly contrasting either in perspective or philosophy. But they did bring out some interesting points on both sides. While I appreciate the effort and research that went into each authors' article, I can honestly say that my position on personal population responsibility has not changed. While I do believe that the Earth has finite resources for a finite number of people, I also believe that there are members of—more often than not—right wing organizations and religions in the USA that continue to have children as if that is their sole mission in life.

Meanwhile my leftish and liberal cohort is keeping to ZPG (Zero Population Growth) plans on having no children at all. At this rate, the Right will out populate the rest of us and kick us out by sheer numbers. Not only do I resent this, I am sickened by the idea that by doing the "right thing" for the planet I am condemning my children and their children to rule by narrow minded right-wing

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fundamentalist quasi-fascists. Further, after having my two children I am not yet content to cut short my reproductive life. I enjoy being large with child and nursing a baby at my breast. I am not ready to give that up. No philosophy or scientific argument can reason with my maternal hormones. I could go on to rationalize that if I have more children, I would be balancing out the population numbers in the long run since several non-traditional couples I know are not planning on having children or cannot. At any rate, I was interested in the readings and am looking forward to my next issues of *Analog*.

MARY J. ROSE-SHAFFER
INTERNET:maryrose@falcon.cc.ukans.edu
423 Mississippi
Lawrence, KS 66044

Dear *Analog*:

I was rather pleased with the increasing ecological awareness shown by so many of your writers (even the two views of population pressure both recognized it as a problem), but one thing needs to be pointed out for basic educational purposes. Nearly everyone has heard the term "global warming" by now, but it's still being treated far too simplistically (i.e., ignorantly). Global warming, which is *already* out of control, due to its serious time-lag nature, does not mean that everything gradually gets a few degrees warmer, which people in Minnesota might even prefer. It means that more and more energy is pumped into that massive heat engine called the atmosphere—and, of course, the ocean. This means wilder weather swings, not gradual warming. More storms (ref. this past summer's hurricane season), more droughts, more heat waves and inversions, more massive snow storms. When the insurance companies begin to understand what global warming is doing, hold onto your wallet. . . .

Micro-g in the KC-135 is still an expensive proposition out of reach for most people, but there is a much cheaper and easier way to experience free-fall: take up gymnastics. (This might still be an out-of-reach alternative for most out-of-shape adults.) Speaking as one who has flown in fighter jets doing maneuvers, and mastered a few comparatively easy stunts on a trampoline, I can say that the experiences are not all that different. (Additional benefit: gymnastics teaches you eye-ear coordination extremely swiftly, as opposed to micro-g, which does not have the incentive of getting it right or landing on your head, so you master "motion sickness" in a matter of seconds. Most trained gymnasts never experience vertigo.) The altitude chamber (oxygen starvation), of course, is a whole different story.

All in all, the January issue was entertaining and above-average. Here's a thank-you for an evening's relaxation, and a wish for happy holidays for all.

DIAN HARDISON
Cocoa, FL 32927

Dear Mr. Schmidt:

I believe in the coming overpopulation crisis. Naturally, I was immediately drawn to "Popubtion and the Future: Two Views Of Our Prospects."

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My concern with Mr. Easton's article is the perpetuation of the concept that overpopulation occurs when the resource base can no longer supply the population base. In this case the production of grain. True, Mr. Easton has fleeting references to socioeconomic consequences, the limits of technology, and environmental repercussion, but these important concepts are never followed up. Any stance which is based on one principal argument is doomed to failure since it is easy to refute and fails to fully disclose the complexity of the problem that overpopulation presents. The introduction supports the concept that the population problem is not one dimensional: The problem is that there are so many variables interacting in complex ways, and neither the variable nor the interactions can be predicted with certainty.

Dr. Gillett was extremely effective in making the case that the population problem is self-correcting. If I believed that overpopulation (as a concept) occurs when the resource base is exceeded, I would side with him. However, I believe that the socioeconomic, technological, and environmental components are equally as important as the resource base. Ironically, Jay Kay Klein's Biolog (the page before the population article) provided an excellent quote for my concern with Mr. Easton's article. Mr. Klein wrote "Although open to every human concern, science fiction has placed a heavier emphasis on engineering and physics than the softer sciences and personal relationships as central to stories." The socioeconomic (soft science) variables truly disclose the human costs incurred as the population approaches 100% resource utilization.

My analytical approach consists of two themes, and is focused (so I guess I owe Mr. Easton an apology, since I won't be hitting all the issues). Theme one: In 1893 Frederick Jackson Turner declared the frontier closed. The social implication of this was that you could no longer escape civilization by moving beyond its fringe. The world is now a closed system and the disaffected members of society no longer have any hope of "escape." As more and more people occupy the Earth, a management problem is created. To function effectively, how we interact is becoming increasingly structured (law and order).

Theme two: As more and more people occupy the Earth, keeping the resources flowing requires increasing organization. To function effectively, the production and distribution systems must become increasingly managed as we approach 100% resource utilization. One potential consequence would be the eventual demise of the free market systems as we know it since resource allocation would be made by a central authority and would be rationed.

The nexus between these two themes is that greater organization means less personal freedom. Mr. Easton was frustratingly close when he concluded his article on the "right" to breed but ended with the traditional (and easily refuted) reminder that we are limited by our resource base. Mr.

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Easton could have picked up significant debate points by concluding that managing our "right" to breed would help preserve our standard of living and personal freedoms. Demonstrating the subtle adverse consequences of overpopulation and the socioeconomic benefits of population control are key to winning converts that we indeed have a population problem which simply can *not* be solved by growing more food. "Solving" specific resource shortages (such as food) will only intensify other problems and increase ecological instability. Further, as Mr. Easton implied, living in a world with 100% resource utilization leaves no survival wiggle room. In fact we may never reach 100% resource utilization as society may well collapse before we actually run out of resources if the disaffected and alienated members of society no longer have any hope that they can benefit by supporting the system.

STEPHEN RYNAS

Duarte, CA

Dear Editor:

Wow! Bud Sparhawk's "Resurrection" (January 1996) is the best "thinker" story I have read in a year and the best one that touches on matters of faith in a very long time. It's in a league with Card's *Speaker for the Dead* and *Xenocide*.

While I have yet to read an SF story from anyone that portrays a Christian protagonist who is not rote-learned, wooden or stereotypical (as opposed to having a truly personal faith), I applaud *Analog*'s running this story because it respects the protagonist's beliefs and remains true to their applicability within his world, yet gently questions their applicability to the newly discovered alien race (the "homaroids"). Even though I could foresage where the story was headed (not a function of the foreshadowing, I think, but my own awareness of such "intercultural questions"), I was continually surprised by how Sparhawk addressed the issues the protagonist was wrestling with. Thanks for publishing this uniquely thought-provoking story.

STEVE DEYO

West St. Paul, MN

The author replies. . . .

Steve,

Thank you for your comments on "Resurrection." While I am honored by your praise I hardly think my little stories are in a league with Card's, but thanks for the compliment.

I am glad that someone out there got the true point of the story and understood how I was trying to depict someone with deep faith, however lapsed. The point that you may have missed, however, is that his interpretation was misplaced and he grossly misunderstood the implications of the alien's declaration. But, true to our kind, he finds the metaphors HE needs to go on with his own life and calling.

BUD SPARHAWK

Dear Dr. Schmidt:

I'm sure some readers will rail against the Jesuit-trained priest in Bud Sparhawk's "Resurrection" (January 1996) for violating the Prime Direc-

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tive, or at the religious beliefs Sparhawk ascribes to the narrator. These don't bother me, but I do wonder about the narrator's grasp of information theory.

The narrator teaches the homaroid Ttch*lok Christian theology, knowing that when homaroids molt, they retain about 20% of their former memory. I understand that in information transfers, 80% data loss is Bad News. What happens to such data after, say, seven moltings? Put it this way: remove at random 80% of the Bible's words. Then remove 80% of that, though six more iterations. What's left?

Perhaps the Jesuits have abandoned theological rigor in Sparhawk's future. But if they haven't, I can picture his narrator-priest breaking into a cold sweat when he finally comprehends the disjointed fragments of the Word that shall be given unto the seventh generation. Unless he can teach Ttch*lok to read and write. . . .

To the railers, Mr. Sparhawk might—*if* applicable—cite Arthur C. Clarke's disclaimer from *Childhood's End*. It goes, roughly, "The opinions expressed in this novel are not those of the author."

RICHARD M. BOOTHE

Los Angeles, CA

Dear Dr. Schmidt:

I wish to express my pleasure with the January 1996 issue of *Analog*. You chose an extraordinarily delightful mix of stories (yes, I read it cover-to-cover). I was especially taken with the novelettes "A Pillar of Stars by Night" by Alexis Glynn Latner and "Martian Valkyrie" by G. David Nordley. As you probably know, I was one of the technical consultants for "A Pillar of Stars by Night" and was glad to see how well it turned out in print. I thought the story had a great deal of merit when I was asked about various technical items, and I thoroughly enjoyed seeing the final product. It is an extremely engaging story. As a scientist at NASA working on planning human missions to Mars, I found "Martian Valkyrie" enticing. Several concepts we have already thought of were well presented. My colleagues and I at NASA have been putting a great deal of effort into the "bootstrap" methods of exploring space. The author's unique combination and contrast of traditional versus "bootstrap" ways of space exploration highlighted the importance of the latter and gave me much appreciated inspiration and food for thought. Thank you for an exciting issue. ■

EILEEN K. STANSBERY

Friendswood, TX

A sexy story larded over with science is something different from a science novel based on sex. Here the possibilities are limitless.

—Eric Temple Bell
(aka John Taine)

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UPCOMING EVENTS Anthony Lewis

4–7 July

CONDIABLO (49th Western Science Fantasy Convention—Westercon) at Camino Real Paso del Norte and El Paso Convention Center, El Paso, TX. Guests of Honor—Howard Waldrop & James P. Blaylock; Artist Guest of Honor—Brad W. Foster; Fan Guests of Honor—Arnie & Joyce Katz; TM—Pat Cadigan. Registration: $60 until 31 May, $70 at the door. Info: Westercon 49, Box 3177, El Paso, TX 79923. 1-800-585-8754 (542-0443 in El Paso). E-mail: af541@rgfn.epcc.edu *or* RichBrandt-@aol.com *or* 71573.2724@compuserve.com.

5–7 July

GAYLAXICON VII (SF/Fantasy/Horror con for gay, etc. people and their friends) at Burlington Marriott Hotel, Burlington, MA. Guests of Honor—Ellen Kushner and Delia Sherman. Registration: $30 until 15 June, $35 at the door. Under 18 must be accompanied by parent or guardian. Info: Gaylaxicon VII, Box 176, Somerville, MA 02143. email: gaylaxians@gaylaxians.org

26–28 July

CONFLUENCE '96 (Western Pennsylvania SF conference) at Sheraton Inn, Mars, PA. Guest of Honor—Michael Swanwick. Registration: $20 until 30 June, $28 thereafter. Info: ConFluence '96, Box 3681, Pittsburgh, PA 15230-3681. (412) 344-0236. Web site: http://www.lm.com/~lmann/fan/confluence96.html

29 August–2 September

L.A.CON III (54th World Science Fiction Convention) at Convention Center, Hilton, and Marriott Hotels, Anaheim, CA. Guest of Honor—James White; Media Guest of Honor—Roger Corman; Fan Guests of Honor—Takumi and Sachiko Shibano; Special Guest—Elsie Wollheim; TM—Connie Willis. Registration: $130 until 15 July 1996; higher at the door. Child-in-tow (3-12 years old in 1996): $35, infants: free, Supporting: $30. This is the SF universe's annual get-together. Professionals and readers from all over the world will be in attendance. Talks, panels, films, fancy dress competition—the works. Join now and get to nominate and vote for the Hugo Awards and the John W. Campbell Award for Best New Writer. Info: L.A.Con III, c/o/ SCIFI, Box 8442, Van Nuys, CA 91409. E-mail: lacon3info@netcom.com

Convention runners: You can send me e-mail about your convention at: A.LEWIS20 on the GEnie& network.

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TECHNOLOGY UPDATE

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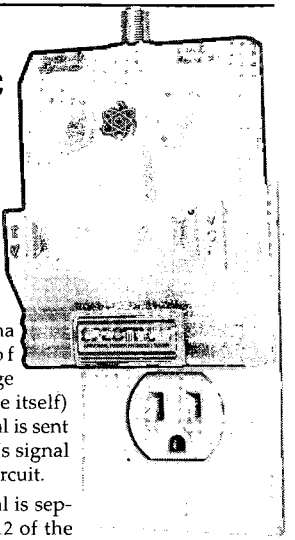
This little box uses your home's electrical wiring to give non-subscribers, cable subscribers and satellite users better television reception!



Fifteen years of microelectronics research has resulted in a remarkable device, the Spectrum Universal Antenna/Tuner, that makes conventional antennas obsolete.

Advanced technology. Imagine a television picture so clear you'd swear you were there...live. Plug the Spectrum Antenna into an outlet, plug your TV into the Spectrum and get ready for great reception!

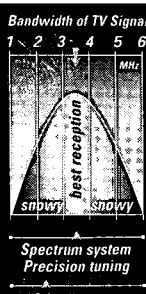
How it works. Broadcast TV signals are sent out from the local station. They interface with your home's AC power line system (a huge aerial antenna network of wiring as large as your home itself) and the signal is sent to Spectrum's signal processing circuit.

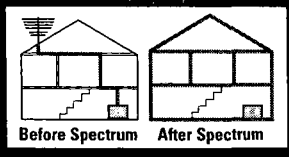
The signal is separated into 12 of the best antenna configurations. These signals route themselves into 12 separate circuits. The *Signal Switch* control gathers 12 of the best antenna configurations. Use the *Signal Search* control to select from the best signal. The *Fine Tuner* circuit gives your TV crisp, clear reception.

Try it risk-free. The Spectrum Universal Antenna/Tuner comes with our risk-free trial and a 90-day manufacturer's warranty. If you're not satisfied, return it for a "No Questions Asked" refund.

Why Spectrum is the best...

- When TV signals are tuned at the TV channel's center frequency, optimum tuning has been achieved.
- Other antennas can't offer center frequency tuning like the Spectrum Antenna can. They only offer such tuning up to the edge of the center frequency. As a result, your TV picture remains snowy.





How does Spectrum use electrical wiring as an antenna? Believe it or not, Spectrum simply "activates" the giant antenna that already exists in your home. Essentially, it uses all of the wiring throughout your home's walls and ceilings to make an antenna as large as your house for unbelievably clear reception of local broadcasting.

The Spectrum Antenna will improve television reception, even on local stations, for:

- *Cable users*
- *Non-cable users*
- *Satellite users*

SPECIAL OFFER. For a limited time, get a special discount on additional units for great reception on all your TVs!

Spectrum Antenna ..... **$39** $4 S&H

Additional antennas just... $34 S&H FREE

Please mention promotional code 1492-AS-1547.

For fastest service, call toll-free 24 hours day

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